Aviation Week

Including **Space Technology**

June 23, 1958

High Energy Solid Fuel May be Hybrid

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It's no wonder that engineers think of the KAYLOCK H20 12-point nut as a "feather light titan." Up to 36% lighter than any other hi-tension 12-point self-locking nut, the H20 provides maximum structural properties of ultimate tensile strength and fatigue life. Kaylock's all-metal, self-locking, elliptical construction makes possible amazing savings in weight while actually increasing performance. Precision wrenching surfaces are designed to withstand full wrench torque requirements of 180,000 to 200,000 psi tension bolt applications (NAS624 series bolts).

Suitable for use in temperatures up to 550°F,– the KAYLOCK H20 offers complete load carrying threads throughout its height and combines a positive self-locking nut element with a permanent-type molybdenum disulfide lubricant. This combination provides for uniform pre-load in the bolted joint – to assure maximum fatigue resistance.

Tension fatigue tests and static tension tests conducted by both Kaynar and aircraft manufacturers, have established its rugged reliability.

Complete line of Kaylock all-metal self-locking nuts available in steel and A-286 corrosion-resistant steel.

KAYLOCK

All-metal self-locking nuts ®

conform to all Air Force - Navy standards: AN363, AN364, AN365, AN366, and the new low height National Aircraft Standards.

Trade Mark

Setting Standards of Progress

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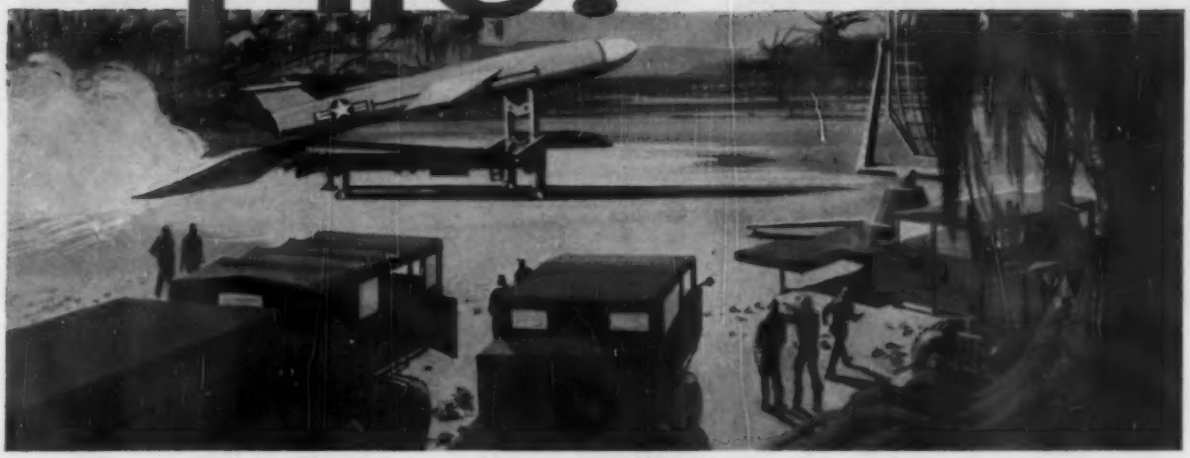

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Adaptable to any missile operation where mobility is vital, Goodyear Aircraft's complete ground support equipment moves swiftly and surely in deep snow, sand or mud—unhampered by weather extremes of from −65° to 125° F! This amazing mobility makes it possible to get out of the area fast once missile has been launched.

Traveling on the unique low-pressure inflated Terra-Tire, the equipment outmodes conventional truck-type vehicles—gives the squadron "go-anywhere" mobility and vastly simplified logistics.

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And mark this: Built around a single type of power unit which is in world-wide military inventory—the concept meets all requirements of ordnance, communications, power and check out.

Individual "packs" for the standardized prime movers include all needed supplies, check-out equipment, perfect guidance system environment, 3 different and independent communication systems—hydraulic, electric and pneumatic power, as well as ground cooling and fuel-start needs!

Here is a major contribution—engineered by a leading team with firsthand understanding of the complete missile concept—a contribution of special importance when one considers that ground support has often run as high as 60% of total missile cost. Please write for details. This experience may solve your problem. Goodyear Aircraft Corporation, Dept. 916AR, Akron 15, Ohio.

Terra-Tire—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

• GROUND HANDLING EQUIPMENT • ONE OF THE PRIME CAPABILITIES OF

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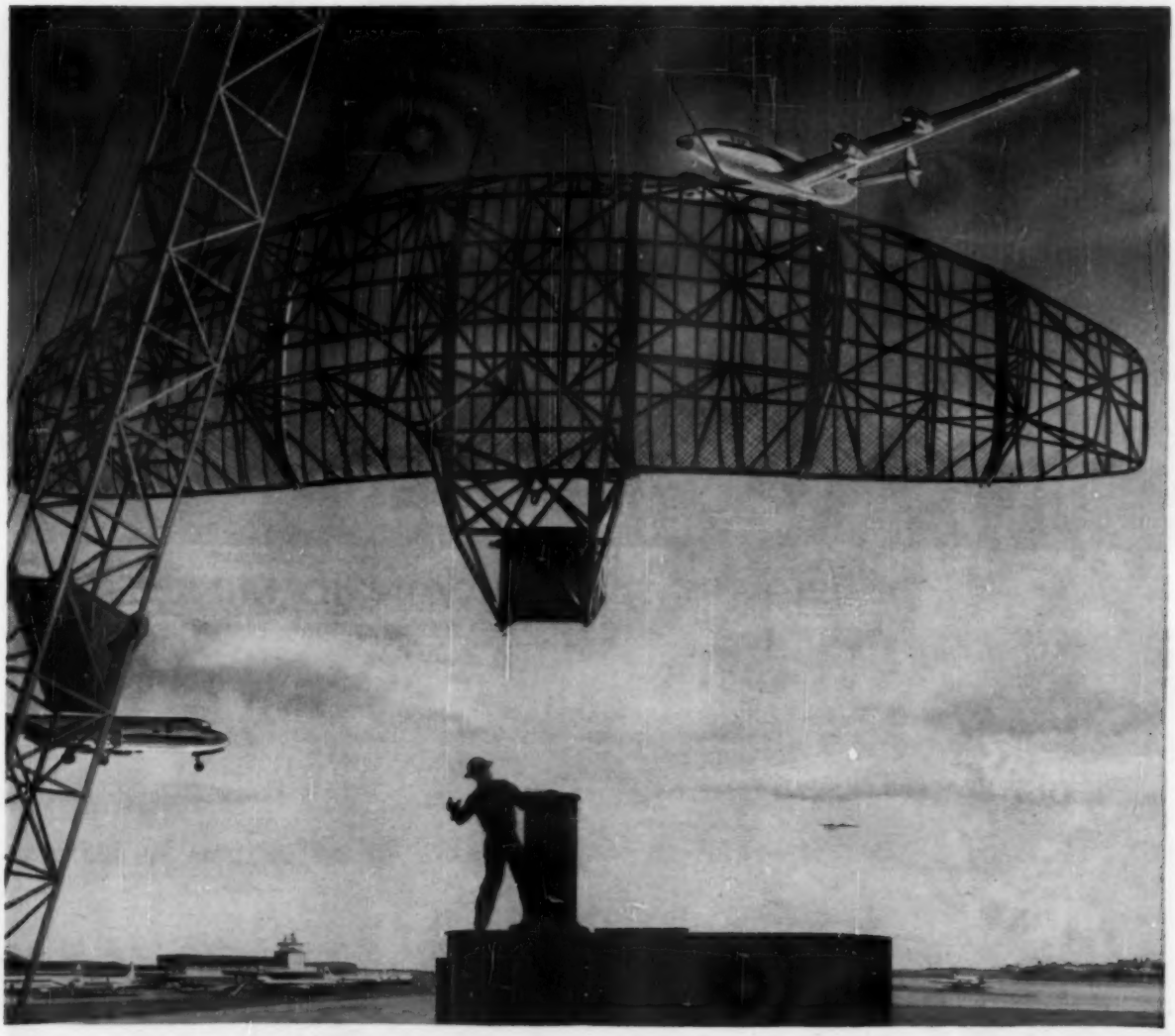
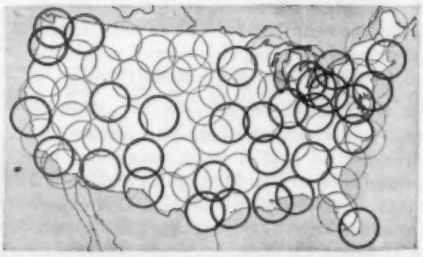


Getting set for jet-age traffic at 27 leading U. S. airports



Raytheon radars at 27 of the 31 heavily circled areas will soon be operating as part of C.A.A.'s flight control network. Light circles indicate future coverage.

"More sky to fly in"—the goal of the Civil Aeronautics Administration—is near realization. The first of the new Raytheon Flight-Tracker radars ordered by C.A.A. is now being installed at Indianapolis. Installations at six other major cities will follow shortly, and the nation-wide system linking 27 airports is scheduled for completion this fall.

Flight-Tracker radars help safeguard aircraft in every stage of flight. They detect and track planes in any weather—even in storms—pinpoint position of four-engine transports up to 200 miles distant, at altitudes up to 70,000 feet.

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RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY, WALTHAM, MASS.

AVIATION CALENDAR

June 30-July 1—Industry Missile & Space Age Conference, sponsored by Aero Club of Michigan, Hotel Statler, Detroit, Mich.

July 4-6—Northeastern States Championship Soaring Contest, Harris Hill, Elmira, N. Y.

July 5-6—Air Race, Professional Race Pilots Assn., Fulton, N. Y. For details: Don Berliner, 19 Hudson Ave., Athens, Ohio.

July 8-11—The Institute of the Aeronautical Sciences, National Summer Meeting, Ambassador Hotel, Los Angeles, Calif.

July 14-15—Triennial Inspection, National Advisory Committee for Aeronautics, Ames Aeronautical Laboratory, Moffett Field, Calif.

July 14-25—Physics of Infrared Radiation Program for research scientists and engineers, Massachusetts Institute of Technology, Cambridge, Mass.

July 20-Aug. 10—Canadian National Soaring Meet, Brantford, Ontario, Canada. American pilots invited.

July 21-Aug. 1—Advanced Feedback Control Theory, two-week Special Summer Program, Massachusetts Institute of Technology, Cambridge, Mass.

July 24-25—Quarterly Regional Meeting, Assn. of Local and Territorial Airlines, Denver, Colo.

July 24-25—Fifth Annual Symposium on Computers and Data Processing, Albany Hotel, Denver, Colo.

Aug. 5—Regional Technical Meeting on Space Exploration, sponsored by American Rocket Society and the Institute of the Aeronautical Sciences. For details: R. D. Linnell, General Chairman, Space Exploration Meeting, 3300 N. Harbor Drive, San Diego 1, Calif.

Aug. 6-8—Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, sponsored by the American In-

(*Continued on page 6*)

AVIATION WEEK Including Space Technology

June 23, 1958

Vol. 68, No. 25

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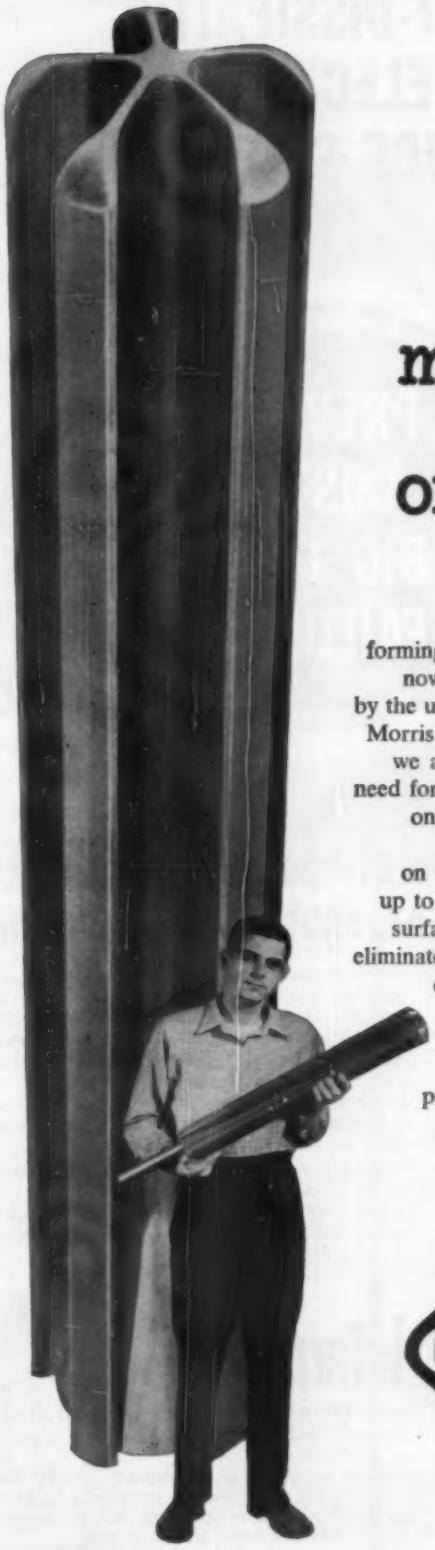

cast mandrels or cores?

Aluminum mandrels for forming solid fuel propellant are now being cast in production by the unusual foundry methods of Morris Bean & Company. While we assume there is no present need for a mandrel as large as the one on the left, it *can* be cast. Currently we are working on solid and hollow mandrels up to 8 feet long. Their smooth surfaces and accurate contours eliminate much difficult machining; cost is drastically reduced. In addition to large size, we would be happy to explore with you ways to produce intricate star-lobes. *Telephone or write.*

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Heat-dissipating electron tube shields for miniature, subminiature octal and power tubes

AVIATION CALENDAR

(*Continued from page 5*)

stitute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.

Aug. 7-9—National Convention, OX5 Club of America, Hotel Statler, Los Angeles, Calif.

Aug. 13-15—Conference on Electronic Standards and Measurements, National Bureau of Standards, Boulder Laboratories, Boulder, Colo. Sponsored by NBS, American Institute of Electrical Engineers and Institute of Radio Engineers.

Aug. 17-23—Missiles Operations Research, Engineering Seminar, Pennsylvania State University, University Park, Pa.

Aug. 18-19—Annual Western Regional Meeting, American Astronautical Society, Dinkelspeil Auditorium, Stanford University, Palo Alto, Calif.

Aug. 19-22—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Aug. 25-30—Ninth Annual Congress, International Astronautical Federation, Amsterdam, Holland.

Sept. 1-7—1958 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 3-5—1958 Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 8-13—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.

Sept. 15-18—Fall Meeting, American Rocket Society, Inc., Hotel Statler, N. Y. C.

Sept. 15-19—Annual Instrument-Automation Conference & Exhibit (International), Instrument Society of America, Philadelphia Convention Hall, Philadelphia, Pa.

Sept. 22-24—1958 Meeting, Professional Group on Telemetry and Remote Control, Americana Hotel, Bal Harbor, Miami Beach, Fla.

Sept. 22-24—Seventh Annual Meeting, Standards Engineers Society, Benjamin Franklin Hotel, Philadelphia, Pa.

Sept. 29-Oct. 3—National Aeronautic Meeting, Society of Automotive Engineers, Inc., the Ambassador, Los Angeles, Calif.

Sept. 29-Oct. 3—Semi-Annual Meeting and Western Tool Show, American Society of Tool Engineers, Shrine Exposition Hall, Los Angeles, Calif.

Oct. 6-7—National Symposium on Extended Range and Space Transmission, sponsored by the Professional Groups on Antennas and Propagation and Communications Systems of the Institute of Radio Engineers and George Washington University, Lisner Auditorium, Washington, D. C.

Oct. 7-8—1958 Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Chateau Laurier, Ottawa, Canada.

Oct. 22-24—Fifth National Vacuum Symposium, Sir Francis Drake Hotel, San Francisco, Calif.

Oct. 27—14th Annual General Meeting of the International Air Transport Assn., New Delhi, India.

Oct. 27-28—East Coast Conference on Aeronautical & Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

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FOR A NEW ARMY RECRUIT

No other helicopter ever has been, or will be tested more thoroughly than the Army's IROQUOIS, Bell's all-new turbine-powered HU-1A. Designed to meet the most exacting standards of performance and maintenance ever required of a helicopter, it has already passed through Bell's own rigorous shakedown.

But, before it goes to work in the field, the HU-1A is being "put through the mill" by the Army. A series of tests — the hardest and most realistic any helicopter ever faced — will cover every phase of performance, supply and transportation, maintenance, weather, combat conditions and general military usage.

By testing, evaluating and proving every piece of aviation equipment, the Army assures that the U. S. armed forces get only the best. And in helicopters, that will be the IROQUOIS — the nation's newest front line fighter.

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THESE AGENCIES WILL PUT THE IROQUOIS THROUGH ITS PACES

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..skilled engineering test pilots will "wring out" the HU-1A for performance and stability Phase 4 tests.

Eglin Field

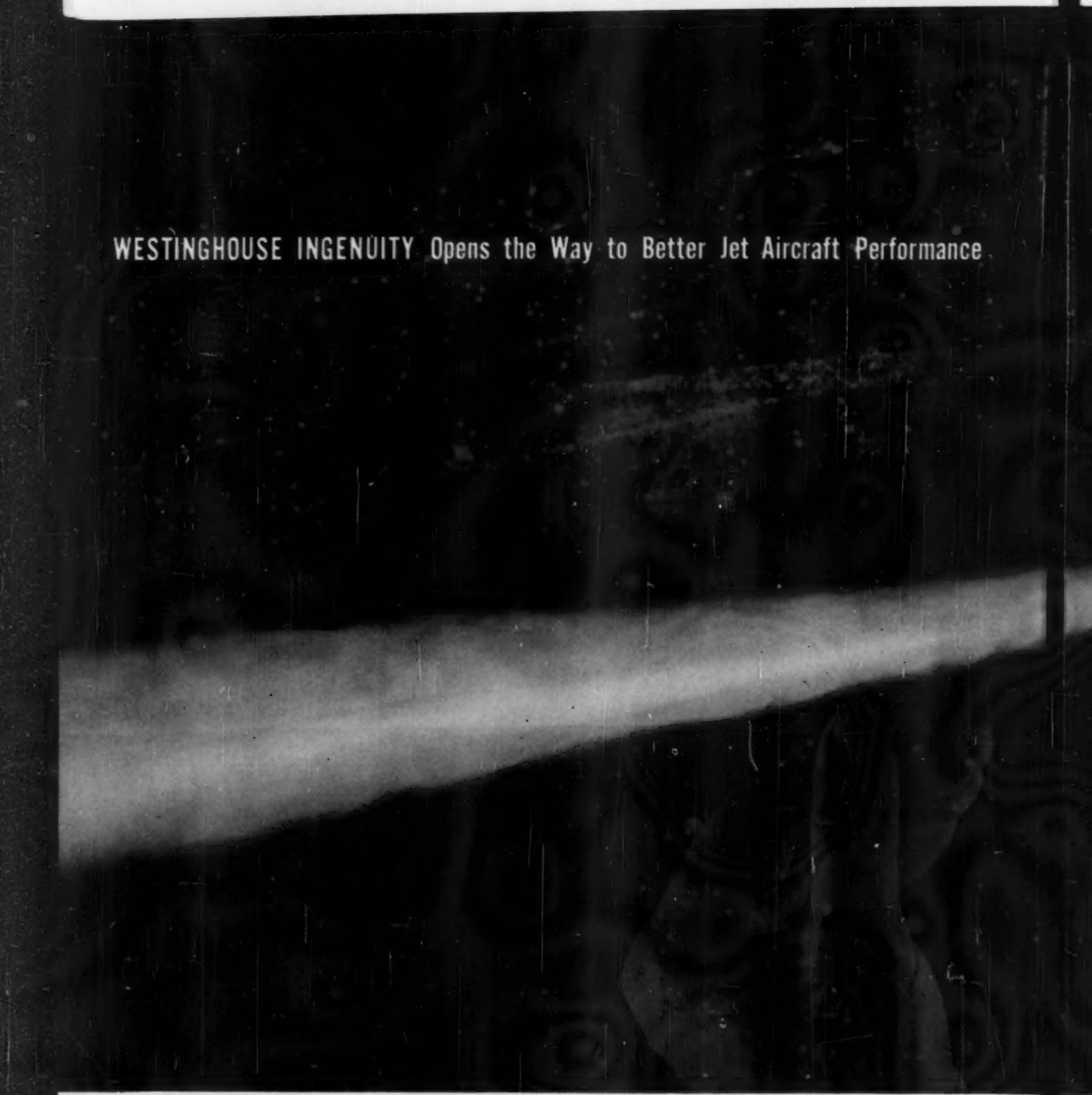
..the Iroquois will undergo performance runs in the climatic hangar at extreme temperatures.

Army Aviation User Tests at Ft. Rucker

..simulated battle conditions will test the Iroquois for frontline dependability from the desert to the arctic.

Transportation Aircraft Test and Support Activity (TATSA) at Ft. Rucker

..1,000-hour logistics support tests.



1004 Jet Inventions in the Last Two Years

Engineering and research scientists at Westinghouse made 1004 invention disclosures—each representing an improvement in jet engine design—during 1956 and 1957. The number of inventions this year is keeping pace with previous years, proving that creative engineering at Westinghouse is striving constantly toward better, more efficient jet propulsion.

Westinghouse, designer and builder of the first American turbojet, now holds more than 175 U. S. patents—many of them basic patents—on the jet

engine. A few of the Westinghouse "firsts" in the field include the axial flow compressor, iris exhaust nozzle, annular combustion chamber and step wall combustion liner.

The Aviation Gas Turbine Division is a completely integrated facility for design, development, testing and production of propulsion systems. For further information, write: Westinghouse Electric Corporation, Aviation Gas Turbine Division, P.O. Box 288, Kansas City, Missouri. J-54047

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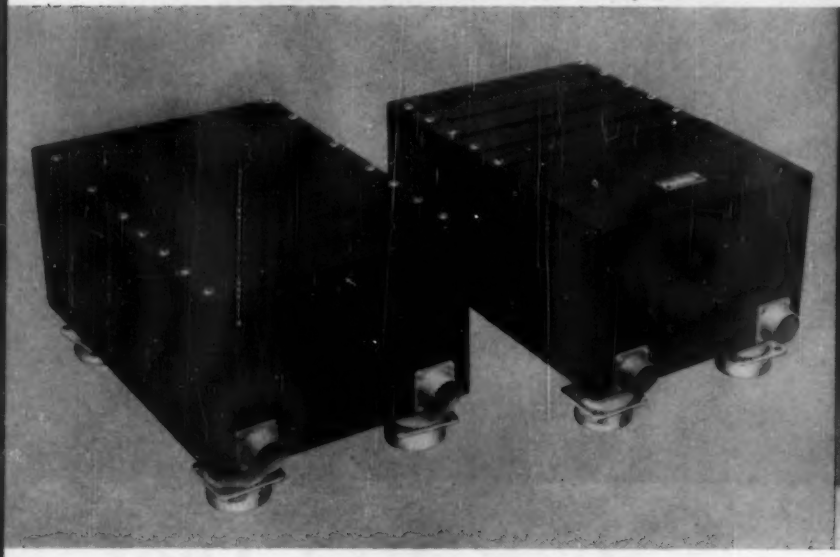

SMALL—0.8 cu. ft.—LIGHT—45 lbs.—with speed and capacity to perform all computation functions for an advanced fighter-bomber—this is one version of **GEVIC**, General Electric's new variable increment digital computer. **GEVIC** is based on General Electric developments of new mathematical techniques and solid-state logic elements. For information on how **GEVIC** and other computer developments can benefit your aircraft, missile, or other applications, send for new LMEE brochure . . . "Computers . . . Abacas to Airborne." **Write Dept F**

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Another Look at the Iron Curtain 13

COVER: Chance Vought F8U-3 Crusader III was recently flown at Edwards AFB, Calif. In addition to a Pratt & Whitney J75 engine (17,500 lb. thrust without afterburner; 26,000 lb. with afterburner), the Navy all-weather fighter is equipped with a rocket engine that would increase rate of climb and permit more rapid acceleration from cruise to combat speed.

PICTURE CREDITS

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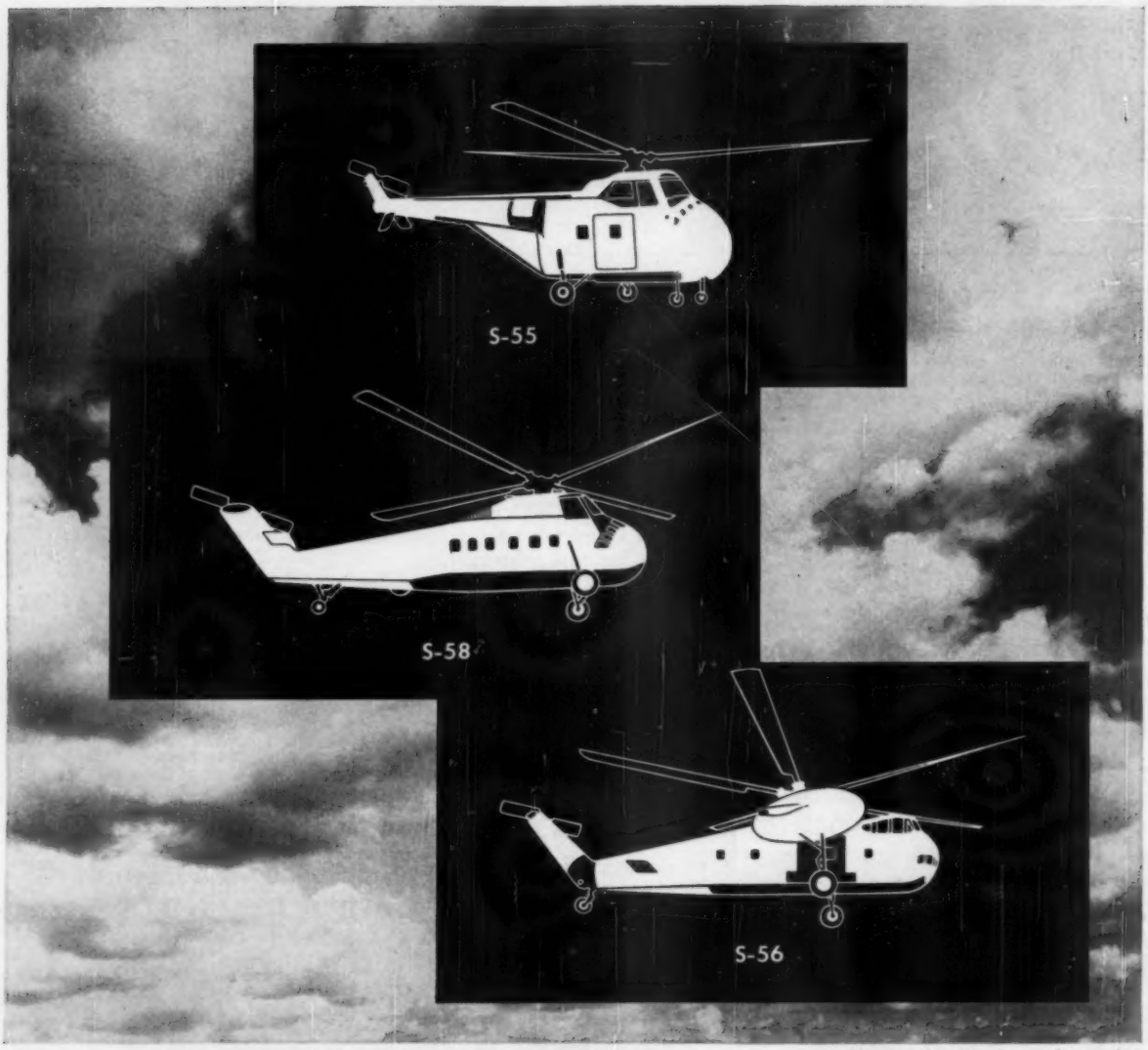

white areas show extensive use of magnesium

MAGNESIUM ALLOYS BUILD BIGGER PAYLOADS INTO SIKORSKY 'COPTERS

Structural dead weight—that ever critical problem in the design of air frames and missiles—is a problem Sikorsky Aircraft solved several years ago.

As every helicopter designer well knows, everything below the rotor is sheer dead weight and contributes nothing to lifting the aircraft. So it's no wonder Sikorsky uses magnesium alloys where they can. This lightest of all structural metals weighs only 65% as much as aluminum. Easy to see how the use of magnesium adds substantially to the payload—by subtracting weight from the structural load.

The S-56, Sikorsky's largest 'copter to date, carries a total of 5,558 lbs. of magnesium. This total includes the wheels, almost the entire skin and numerous other components. Several highly stressed areas, such as the rotor hub plates, are magnesium forgings. Other Sikorsky models, such as the S-58 and S-55, famous Korean War 'copter, also use magnesium alloys to good advantage.

For more information about magnesium, contact your nearest Dow Sales Office or write THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1402-K-2.

MAGNESIUM FORM	LBS. USED		
	S-55	*S-58*	*S-56*
Sheet	580	1303	2288
Extrusions	68	51	246
Castings	307	266	1466
Forgings	77	198	1144
Bar and Tube	83	186	414
Total	1,115	2,004	5,558

YOU CAN DEPEND ON DOW

EDITORIAL

Another Look at the Iron Curtain

Last week, we took our second look at the iron curtain from high in the watchtower of an ancient Bavarian castle. Our first experience with the iron curtain was just about two years ago this month when we journeyed to Moscow to report on the Tushino air show and visit with Gen. Twining and his staff, Soviet air force installations. We hit the iron curtain at Riga, capital of one of the Baltic states.

There, the iron curtain had been temporarily torn wide open. Green uniformed border guards didn't even open luggage. The passport examination and currency declaration was perfunctory. During a flight delay due to weather, Soviet officials traveling on the same plane produced cognac for foreign travelers and challenged us to produce any evidence of a real iron curtain. The same atmosphere prevailed in Moscow during our visit.

Soviet censors did not delete a single word of my dispatches cabled from Moscow, although they were filled with technical details of new Soviet military aircraft and revealed for the first time details of Aeroflot's jet expansion plans, including technical data on new transports that did not fly until a year later. We were allowed to take pictures of anything, including military aircraft, and wandered freely around the city.

All this was in a period when Soviet leaders were de-emphasizing Stalin and trying to loosen the iron bands of terror he had forged. As we were leaving Russia, the first sparks of revolt flared in Poland, and the Hungarian revolt soon followed.

A second look at the iron curtain last week presented a radically different aspect. We flew in Seventh Army Sikorsky H-37 helicopters from a strip on the edge of Nurnenberg originally built of granite as a parade ground for Nazi party rallies. Flying over the former spiritual capital of Adolph Hitler's planned thousand-year empire should be a compulsory maneuver for any future ambitious dictators. Grass grows high in the vast amphitheatre where Nazi legions once tramped and "sieg heiled." The vast building Hitler planned to house his congress of satellite nations lies as a half finished ruin, and the once beautiful medieval center of town is still mostly rubble.

We flew over a placid Bavarian countryside filled with farmers stacking hay and over precisely manicured pine forests. Young Army pilots dropped the helicopters low behind the crest of a pine topped ridge and snaked around its contours to settle in a hayfield screened by terrain from surface observation. Nearby was the border patrol camp of Company G, Third Battalion, Second Armored Cavalry, commanded by Capt. Garland McSpadden. From this camp, units patrol a hundred mile section of the German-Czech frontier.

We piled into a bus and, escorted by a pair of machinegun-armed jeeps, wound along narrow roads through dense pine forests so thick that not a single ray of bright sun hit the forest floor and through sleepy villages, each marked by an onion shaped church tower. At Hohenburg, on the banks of the Eger River, we climbed the watchtower of an ancient Bavarian castle. From slits originally designed for archers, we could see the iron curtain and well into Czechoslovakia.

The iron curtain here is a virtually impenetrable barrier designed, as are all aspects of Soviet repression, to keep the people inside sealed from the outer world rather than to prevent the outer world from knowing what's going on in the Soviet Union and its satellites. The actual border is the winding Eger River only a stone's throw from our observation post, and the grass is just as green on either side of this sleepy stream.

About a quarter mile behind the legal boundary, the iron curtain is raised. First, there is a freshly ploughed strip about 200 yards wide that runs from one end of the border to the other. Behind it are hedgehogs of barbed wire fence charged with electricity. Border guards see rabbits and other small game who wander into the fence by mistake sizzled by the electric charge. Every few hundred yards are raised wooden watchtowers, each within sight of the next one. We could see Czech border guards watching us through their glasses.

From Hohenburg, we could see Czech guard kasernes located just behind the wire fence. In the yard of one were clearly visible targets for grenade throwing practice and human target silhouettes for tommygun practice. The border fence is also spotlighted at night at key spots and studded with trip flares along its entire length.

Czech border guards are highly trained, politically reliable troops separate from the regular army. They have orders to shoot on sight anybody crossing the river and often do. Despite all this security, an average of four persons a month filter through to freedom.

This area has long been a source of friction. This was a key spot in the pre-war Hitlerian agitation over the Sudeten Germans put into Czechoslovakia by the Versailles Treaty. Potential for trouble still exists.

This formidable iron curtain bristling with bayonets, bullets and barbed wire is more typical of what is now transpiring in the Soviet Union. The Polish and Hungarian revolts plus Yugoslav independence and internal troubles in China proved that you can't rule a dictatorship by semi-benevolent methods. The execution of Imre Nagy and Pal Maleter, leaders of the Hungarian revolt, is sending shudders of revulsion through Western Europe and has taken what little bloom was still left on Mister Khrushchev's supposed policy of sweetness.

Every informed Western European source we have talked with in recent days views the Hungarian executions as a return to naked terrorism within the Soviet regime as the only method that can possibly hold the Soviet Union and its satellites together. It also is widely predicted that a reign of terror will begin again internally within the Soviet Union with Georgi Malenkov as the first victim of an old-style Stalin-type public trial for crimes against the state, with the inevitable verdict of execution. How this return to terrorism will affect the Soviet industrial, managerial and scientific classes, who now wield considerable power and are the key to the Soviet's international position in the future, will be an aspect to watch closely. It was these classes who seized on this relatively new freedom of the post-Stalin era most eagerly.

All of this may not have much specific concern with aviation and its related technologies, but it is a vital part of the world we live in and something we should think about long and clearly.

—Robert Hotz

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WHO'S WHERE

In the Front Office

Ira G. Ross succeeds **Dr. Theodore P. Wright** as president, Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y. Dr. Wright continues as board chairman.

George A. Lagassa, vice president-manufacturing, Titeflex, Inc., Springfield, Mass.

Dr. Herman Epstein, vice president-engineering, Tele-Dynamics, Inc., Philadelphia.

Vernon N. Ferguson, vice president-operations, L. B. Smith Aircraft Corp., Miami.

D. V. Rowton, vice president-sales, The Hydrodyne Corp., North Hollywood, Calif.

C. L. Stewart, a vice president, Northwest Orient Airlines.

Albert W. Sommerfield, vice president, treasurer and a director, Clary Dynamics Division, Clary Corp., San Gabriel, Calif.

M. Lee Rice, vice president, Atlantic Research Corp., Alexandria, Va. Also: **Presson S. Shane,** director of the newly established Solid Propellant Division, and **Robert O. Webster,** director of the newly established Mechanical Engineering Division.

Convair Division of General Dynamics Corp. has appointed the following to the staff of the vice president-engineering: **Karel J. Bossart,** as assistant for missile engineering, and **Dr. John C. Clark,** as technical and scientific assistant.

Morris Shipley will head a new State and Community Affairs Department for American Airlines, Inc. **Dwight D. Taylor** succeeds Mr. Shipley as assistant vice president in charge of the Washington, D. C. office.

Col. Paul A. Campbell, Director of the Space Medicine Division of the Air Force School of Aviation Medicine, San Antonio.

Rear Adm. Wellington T. Hines succeeds **Rear Adm. William A. Schoech** as Deputy Chief and Assistant Chief of the Bureau of Aeronautics, USN, Washington, D. C.

Rear Adm. G. H. DeBaun (USN, ret.), a director, Aircraft Radio Corp., Boonton, N. J.

Paul P. Huffard of Union Carbide Corp., a director, Greer Hydraulics, Jamaica, N. Y.

Honors and Elections

L. Eugene Root, Lockheed vice president and Missile Systems division general manager, has been awarded an honorary Doctor of Science degree by the College of the Pacific, Stockton, Calif.

J. H. Kindelberger, board chairman of North American Aviation, Inc., has received an honorary Doctor of Laws degree from Howard University, Washington, D. C.

Dr. Chauncey Starr, vice president of North American Aviation, Inc., and general manager of its Atomic International Division, has been elected president of the American Nuclear Society.

Robert B. Hotz, editor of AVIATION WEEK magazine, was presented the 1958 Air Power Award by the New York State Wing of the Air Force Assn. "for his courageous, outspoken efforts in bringing to the nation a true status of our national aviation problems without regard for politics, service or business interest."

(*Continued on p. 83*)

INDUSTRY OBSERVER

► Goodyear Aircraft Corp. won the prime contract for Navy's Subroc underwater-to-air-to-underwater anti-submarine missile after a highly competitive race in which more than 130 proposals were submitted.

► **Air Force is establishing a facility at Holloman AFB, N. M., to keep tab on the growing number of earth satellites. New space vehicles tracking facility, including computation capability for accurate determination of precise orbital position data, will employ optical trackers initially, supplemented later by infrared and radar trackers.**

► Schweizer Aircraft Co., Elmira, N. Y., is developing a small single-place airplane with beefed-up sailplane wings and tail surfaces that may be marketed in kit form. Indications are that the aircraft will gross about 900 lb., take an engine in the 65-95 hp. class.

► **Another radically different type of infrared detector, which shows promise of sensitivities that are 1,000 to one million times better than existing lead sulphide cells, has been developed by General Bronze, Garden City, N. Y. Device employs semiconductor crystals mounted in waveguide cavity excited by microwave energy. Device employs different principle from ultra-sensitive detector developed by Trionics Corp (AW May 26, p. 23).**

► Airways Modernization Board search for contractor to develop Automatic Ground-Air Communication System (AGACS) has been narrowed down to four companies following evaluation of 14 proposals: Bendix Radio, Hughes Aircraft, Radio Corp. of America and a joint proposal by Stromberg-Carlson and General Precision Laboratory.

► **USAF is negotiating with American Bosch Arma Corp. for at least pilot quantity of inertial guidance systems to be used in some models of the Atlas intercontinental ballistic missile instead of General Electric command guidance system (AW April 28, p. 74). Arma guidance will still be used in Titan ICBM, for which it was originally developed (AW May 12, p. 92).**

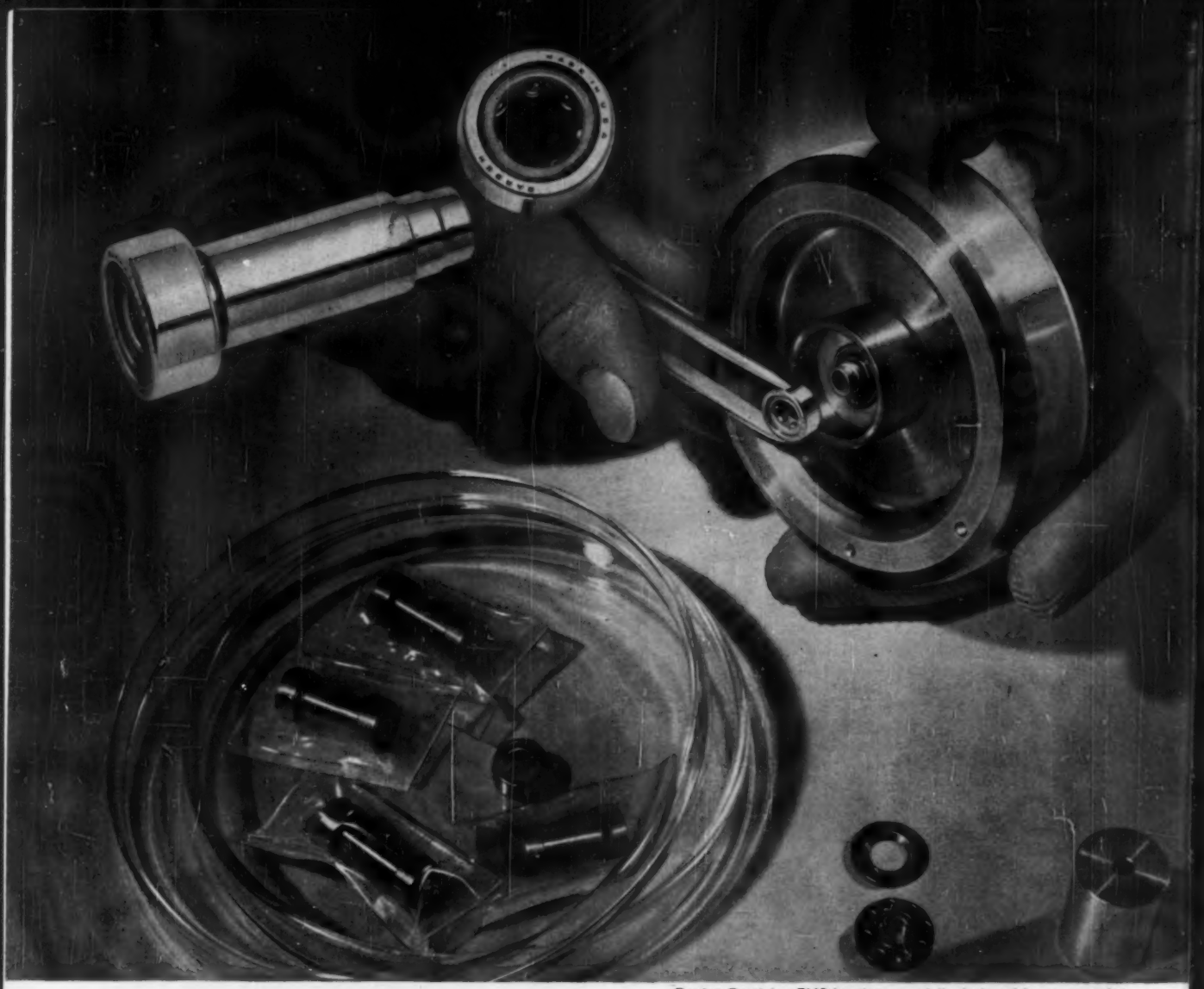
► New version of Navy's Bullpup air-to-surface missile will be developed by Martin Co. for use by Air Force's Tactical Air Command.

► **Air Force will combine developmental flight testing of Republic F-105 with suitability evaluation and training tests at Eglin AFB, Fla., in an effort to slash the usual time by more than 50%. Telescoped F-105 test program is being directed by Lt. Col. Robert Scott of Tactical Air Command headquarters.**

► Navy Bureau of Aeronautics has transferred its airborne instruments branch, responsible for flight control and flight instruments, from the Airborne Equipment Division to the Avionics Division. Move further consolidates BuAer's avionics activities in the latter division.

► **Air Force's new 35,000-ft.-long supersonic rocket sled track at Holloman AFB will go into operation in August. Rocket sled, which will have top speed of around 2,500 mph. will be used for subjecting missile/aircraft components to extremely high-G forces. New facility is nearly 10 times the length of the original track.**

► De Havilland aircraft is quietly surveying U. S. business plane operators to get their reaction of its new Diplomat Executive Transport Project designed as a Beech 18 replacement. Diplomat basically would be an improved DH Dove with the same capacity—8-11 passengers—but powered by two new Lycoming GSO-720 supercharged engines of 520 takeoff hp. each, giving a cruise speed of about 240 mph. at 10,000 ft. and ceiling of about 25,000 ft. Other changes include a new tail and a slightly longer fuselage, with the nose extended to take weather radar. Project is still in the design stage with a go-ahead by the British firm hinging on results of its market survey. Beech also reportedly has a tricycle-geared Model 18 replacement on its boards which is designed around the Lycoming GSO-720.



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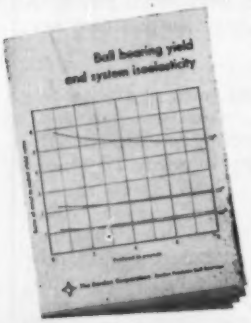

Write for the Barden booklet, "Ball Bearing Yield and System Isoelasticity." An aid to application of precision instrument bearings, it offers background data on axial and radial play, axial take-up, preloading, isoelastic bearings and achievement of system isoelasticity.

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Washington Roundup

Missile Defense Coordination

Three man committee has been formed by Defense Department to integrate and coordinate the nation's ballistic missile defense program, under the chairmanship of Dr. H. R. Skifter, member of the staff of the Assistant Secretary of Defense for Research and Engineering. Other two members are John Klotz, director of defensive missiles in the office of W. M. Holaday, DOD director of guided missiles, and Dr. Herbert York of the Advanced Research Projects Agency. Move is expected to strengthen Defense Department control over Army's Nike Zeus ballistic missile defense system and Air Force's ballistic missile early warning system.

ARPA Facility Funds

The $50 million requested for Advanced Research Projects Agency in the Fiscal 1959 Defense Department military construction bill will be used to build satellite tracking and other undisclosed facilities to be operated by military services rather than for major research centers, with a corresponding staff expansion, for itself, as some observers had believed. Funds will be contracted through military services.

Space Conferees

A blue ribbon conference committee was appointed last week to resolve differences between Senate and House bills designed to create a National Space Agency (see page 20). Committee members are:

Senators Lyndon Johnson (D.-Tex.), Richard B. Russell (D.-Ga.), Theodor F. Green (D.-R. I.), John L. McClellan (D.-Ark.), Warren G. Magnuson (D.-Wash.), Styles Bridges (R.-N. H.), Alexander Wiley (R.-Wis.), Bourke B. Hickenlooper (R.-Iowa) and Leverett Saltonstall (R.-Mass.). Representatives John McCormack (D.-Mass.), Overton Brooks (D.-La.), Brooks Hays (D.-Ark.), Leo W. O'Brien (D.-N. Y.), Lee Metcalf (D.-Mont.). Gordon L. McDonough (R.-Calif.), James Fulton (R.-Pa.), Kenneth Keating (R.-N. Y.) and Gerald Ford (R.-Mich.)

Defense Information

New opposition to consolidation of all military information activities under Murray Snyder, Assistant Secretary of Defense for Public Affairs, is developing in Congress. Last week Sen. Margaret Chase Smith (R.-Me.) and Sen. Henry Jackson (D.-Wash.) protested to Secretary of Defense Neil McElroy plans to transfer the congressional liaison offices of the three services to Snyder's office. "Why change a good system for the inefficient and non-cooperative attitude of the Public Affairs Office?" Sen. Smith asked. McElroy's assurances that the consolidation would in no way affect the flow of information to members of Congress was challenged by Jackson, who declared: "It has already happened in my case." He charged that service officers and officials "are under compulsion not to talk except through the Secretary of Defense. . . . Everything is security until the Secretary of Defense decides it isn't security."

The consolidation was directed by the President.

Rep. John Moss (D.-Calif.), chairman of the House Information Subcommittee, challenged that a directive to implement the plan gives Snyder "immense personal powers to decide what the American people may be told about their own dearly-bought security. By his own admission before Congress, Snyder has reserved for himself the right to decide what news from the Pentagon shall be blue-penciled for security reasons as well as what will be edited out for what he terms 'policy' and 'timeliness'." Moss pointed out that the directive "encompasses not only the power to suppress honest differences of opinion which arise in the military services about the nation's ability to defend itself but lodges . . . (in Snyder's office) the punitive machinery for disposing of doubts through the promotion system of service personnel, themselves."

AMB Vacancy?

James L. Anast, acting technical director of the Airways Modernization Board, will leave the agency to join industry, probably as a vice president of Lear, Inc., within 30 days unless topside pressure at AMB causes him to reconsider.

Holaday Views Sputnik

William M. Holaday, Defense Department director of guided missiles, says he found it "difficult to understand the reaction of many people to the first Russian Sputnik." To these people, Holaday added, "something seemed to have been lost, and the only course of action that they could understand was to scatter in all directions seeking its recovery."

Rate of Return Dispute

Local service carriers are fuming over Irving Roth's explanation of how CAB's Bureau of Air Operations arrived at a suggested rate of return of 9.5% for the locals. Roth, associate director of the Bureau, told a House Appropriations subcommittee the percentage reflected the difference between an 8% rate established during World War II and current rates on short term loans.

The carriers termed Roth's statement the "last straw" designed to put a "better looking face" on the complicated cost of capital approach now being offered in current Rate of Return-Local Service Carriers hearings. They claim that wartime interest rates were the lowest in history and cite figures of the Federal Reserve Board which quote an average interest rate in 1940 at .1% for short term loans. Local service carriers now pay an average rate of 5.3% on four to six month loans.

Minor Victory

Seven local service carriers won a minor victory last week when CAB's Bureau of Air Operations agreed to raise their operating margin allowance to two and a half cents per revenue plane mile, pending final outcome of the Rate of Return-Local Service Carriers Case. Central, Trans-Texas, Frontier, Lake Central, North Central, Ozark and Southern Airlines were named to receive a half cent increase in present rates on grounds that their respective investment base is too low to warrant application of the Bureau-favored 9.5% rate of return based on investment. Carriers are pressing for adoption of a return to either 10% of commercial revenues or one third to one quarter of a cent per available seat mile.

—Washington staff

PIED PIPER reconnaissance satellite will be launched with Thor IRBM booster soon after pad is completed at Cooke AFB . . .

Work on Pied Piper Accelerated; Satellite

Washington—Initial versions of the Pied Piper reconnaissance satellite, the Air Force's first out-of-atmosphere Sentry system, will have a clamshell nose cone orbiting in an inverted position in a north-south path.

Work on Pied Piper is being accelerated at the Missile Systems Division of Lockheed Aircraft Corp., systems contractor for the space reconnaissance project, known as WS-117L, in order to have the Sentry satellite ready and waiting when the new launching site for Douglas' Thor intermediate range ballistic missile at Cooke AFB, Calif., is made available this December or in January, 1959. There is no intention of making a prior announcement of the timetable for the first Pied Piper.

Cooke AFB, being prepared as training site for ballistic missile crews, also will have launch capability for both intermediate and intercontinental-range ballistic missiles.

Original planning was to launch the first Pied Piper from Cooke in October, but facilities won't be ready by then. Thor booster—because it is available, relatively proven and inexpensive—will be used for initial firings until the Convair Atlas ICBM, projected booster for final versions of the satellite Sentry system, is made available. Atlas pad at Cooke will be completed sometime after Thor pad is made ready.

Highlights of Pied Piper Sentry satellite, now being readied, include:

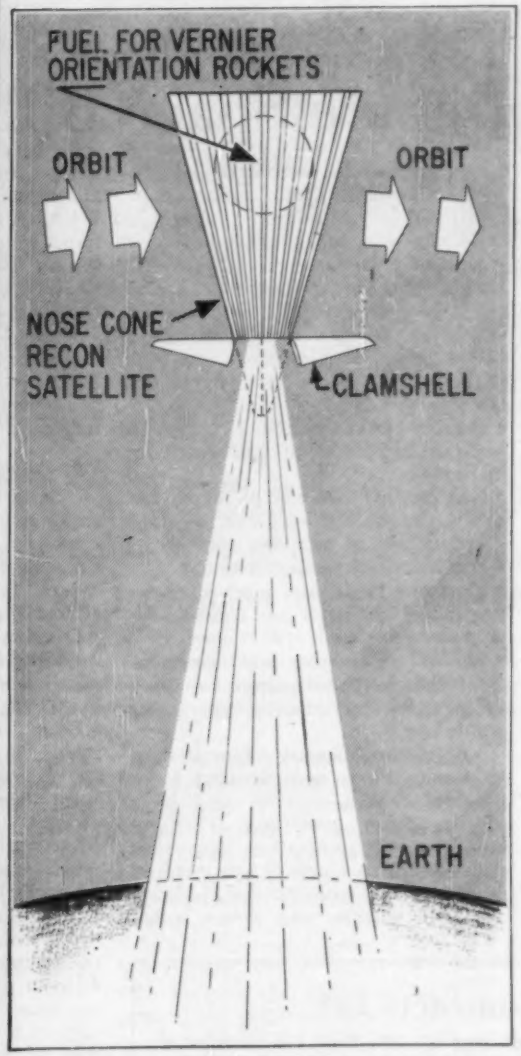
• **Nose cone of the boost vehicle** will function as satellite. Cone's apex will be oriented downward in orbit, clamshell configuration will open for camera within to view atmosphere and terrain.

• **Orientation of the satellite** to keep the camera aimed toward the earth will be a critical problem. Cone is projected to carry vernier rockets for this job, with spherical tank for liquid fuel programmed to feed the rockets for attitude control.

• **First Pied Piper Sentry satellite** probably won't be fitted with a camera but will carry instrumentation and serve as a preliminary shot to determine operational conditions.

• **Succeeding Pied Pipers** will be fitted with optical cameras, will give first pictures from an orbiting vehicle, will reveal how atmosphere, cloud cover and dust affect photos. Photos will be of various earth areas.

• **Early versions of picture-taking** Pied Pipers will be scheduled to make relatively few passes in orbit, because the



. . . Clamshell of the Pied Piper nose cone satellite capsule opens for camera viewing.

Has Clamshell Nose Cone

present scheme is to test the fundamentals of the system quickly. Film from optical camera probably will be recovered by parachute or an equivalent system programmed to operate at reasonable altitude, a difficult job. Radio transmission of photo results probably won't be used in early Pied Piper versions in order to prevent universal monitoring of actual results.

There are no immediate plans to adapt television cameras to the Pied Piper system, nor is there any plan now to incorporate within the near future a scheme for recovering a reconnaissance satellite complete with its equipment, although this type of recovery was under consideration a few months ago. Neither is a manned version of the satellite being detailed at this time. However, the entire program is a "growing" one and is being planned flexibly so that any refinement may be programmed with minimum complexity if sufficient support is allocated.

• **North-south orbit will be used** so that the potential will be available to photograph any portion of the earth as the latter revolves on its axis beneath the orbital path. Launching will be in a southerly direction from Cooke because of the absence of land masses below this trajectory. An attempt will be made to keep the orbit as circular as possible.

• **Altitude of orbit varying** with successive shots, will range to 400 mi.

• **Weight of some of initial Pied Piper** satellites may be as high as 1,500 lb., depending upon the equipment installed. First satellite may weigh as much as 1,200 lb. if present plans are realized. Lockheed will test components thoroughly before the first shot to insure the success of the firing.

• **Avionic and tracking experts** from the Missile Systems Division are now in Hawaii establishing receiving and observation facilities for the operation.

• **Telemetering package,** a Lockheed development, is now ready. Data-reduction equipment also is ready.

• **Cone-satellite** still is being worked on. Makeup will incorporate a magnesium-thorium alloy. Corrugation arrangement on the cone-satellite may serve as surface "standoffs" to house antenna strips and possibly to function as a photoelectric surface to absorb solar radiation for power, although this latter use probably would not be warranted for early development versions.

• **Parts for the satellite** are being fabricated at the Division's Van Nuys, Calif., location. Assembly is under way at the division's Sunnyvale, Calif., site.

• **Thor booster** will have to be coupled to additional stages if satellite of 1,200 lb. to 1,500 lb. is to be put into 300-to-400 mi. orbit. One of the additional stages, probably the second stage, likely will be a liquid propellant rocket.

Initial projection for Pied Piper contemplated funding for only five or six satellites. The project moved along on a hand-to-mouth existence, and Lockheed even invested its own funds in contemplation of expanded project support. Under accelerated support, which may run as high as $260 million over the next two-year period, a vastly expanded reconnaissance satellite program may be instituted. The program may extend at least over a five-year period and encompass a minimum of 20 Sentry vehicles for a variety of orbits and altitudes and fitted with a complete range of scanners—television, infrared, radar and optical—as these, along with refined transmission and receiving equipment, are tailored to fit the special needs of the reconnaissance system.

Division personnel close to the Pied Piper Project include L. E. Root, Lockheed vice president, general manager of the division and its long range planner; Dr. Louis Ridenour, the division's assistant general manager for research and development; Dr. Ronald Smelt, head of the division's research and development branch and former chief of British missile work, and J. H. Carter, weapon system manager.

New Designation

New Lockheed designation for the WS-117L Pied Piper reconnaissance satellite project is Sentry. Earlier company designations for the Air Force program included Big Brother and Advanced Reconnaissance System.

House-Senate Debate Space Bill Conflicts

By Ford Eastman

Washington – Conferees were appointed last week to iron out differences between the House and Senate on legislation designed to create a National Space Agency.

The Senate sent the measure to conference by rejecting the House version approved earlier and adopting its own which differed in a number of respects.

Both versions, however, agreed in principle with Administration recommendations that non-military space projects should be under civilian control and that the National Advisory Committee for Aeronautics should form the nucleus of the new agency.

Points of Conflict

Major points of conflict which the conference committee has been called upon to solve include:

- **Whether the agency will be headed** by a single director assisted by a 17-man advisory committee, as the House wants, or by a seven-man policy board over an operating agency with a single director.
- **Whether there should be a** Joint Congressional Committee on Aeronautics and Space as detailed by the Senate or separate House and Senate committees.
- **Pay scale to be prescribed** and the number of super grades to be established in the administrative, scientific and engineering classifications.
- **Amount of authority** to be provided for the transfer of functions or agencies to the new agency.
- **Whether the bill should contain** a patent rights provision similar to that in the Atomic Energy Act as the House has provided.
- **Degree of jurisdiction** the Defense Department will have on purely defense matters.
- **Division of authority between** the agency and the Defense Department on development of weapons systems or space projects of military nature.
- **Procedure the agency must follow** in negotiating contracts for construction or expansion.
- **Method of entering into agreement** with other interested nations to ensure the peaceful application of outer space exploration.

The House followed Administration recommendations and provided for a powerful civilian director aided by a 17-man advisory committee. The Senate, however, approved a seven-man policy board to supervise activities and designate responsibility for projects, while the director and agency would have administrative and operational authority.

Under the Senate plan the policy board would be established in the Executive office of the President and be composed of the Secretary of State, Defense Secretary, Atomic Energy Commission Chairman, the director of the new space agency and the heads of three other government agencies concerned with aeronautical and space activities.

Opposition to Senate Plan

Considerable opposition to this provision is expected from House conferees as well as from the Budget Bureau, the Defense Department and the White House. Arguments advanced against this provision include:

- **Decision-making process of a board** would be slower than a single director which would slow down the national space program.
- **Board composed of high-level** personnel, such as the Secretary of State and Defense Secretary, would be unable to devote sufficient attention to the program and would often be unavailable, resulting in the designation of subordinates to attend meetings.
- **Board's decisions would be delayed** by the process of the subordinate having to obtain concurrence of his superior before action could be taken.
- **Under the language of the Senate** provision, the board could assign space projects as it saw fit with no assurance that the space agency would be given the assignment. The new agency would become just another of the many government agencies in the field of space.
- **By placing the policy board** in the executive branch, there is a danger that Congress would lose its power of effective overseeing of the board.
- **Policy board would be all-powerful** and control the space program instead of the agency created for this purpose.
- **Frequent changes of personnel** in the departments named on the board would retard the space program until new personnel became familiar with its activities. It would lack the continuity possible under a permanent space agency.

Pay Scale Debate

Another question to be considered by conferees that will have a profound effect on the operation of the new space agency is the pay scale and number of super grades permitted.

The House placed a limit of 10 administrative super grades at a top salary of $21,000 and 250 scientific and

Dyna-Soar Contracts Let

Washington—Air Force last week awarded contracts for the Phase I development of the Dyna-Soar boost-glide, orbital reconnaissance bomber to two teams of contractors headed by the Martin Co. and Boeing Aircraft Co. Choice of the two groups of firms to develop competing designs for production contracts climaxed a hard-fought competition period of about three and one-half months during which a large portion of the major airframe, engine and avionic companies in the country participated in some manner. Winning groups were:

- **Boeing Airplane Co., prime contractor. Associated contractors in the project are General Electric Co., Ramo-Wooldridge Corp., Autonetics and Missile Development Divisions of North American Aviation Inc., Chance Vought Aircraft Inc. and Aerojet-General Corp.**
- **Martin Co., prime contractor. Associated contractors are Bell Aircraft Corp. and Minneapolis-Honeywell Corp. Large portion of the design work on the orbital vehicle itself will be carried out by Bell, which has been working with boost-glide concepts since the Bell X-1 research vehicle.**

Apparently only about $5 million in Air Force funds have been allocated to the program, but final cost of each vehicle was placed in the neighborhood of $150 million by Richard E. Horner, Assistant Secretary of the Air Force, in testimony on Capitol Hill. Horner also indicated that the Dyna-Soar concept has been in the study and component experimental phase for about five years.

Dyna-Soar is a contraction of the words "dynamic soaring" and is used to denote a vehicle that derives a major portion of its lift from centrifugal force as well as aerodynamic forces.

Dyna-Soar vehicle would perform two primary military missions, according to Horner—reconnaissance and strategic bombardment. He indicated that weapons could be dropped or expelled from such an orbital vehicle and then could be guided to their target. A wide variety of reconnaissance packages could replace a weapon load.

Navy's F8U-3 Crusader III Is All-Weather Fighter

Chance Vought F8U-3 Crusader III, which recently made its first flight (AW June 9, p. 21), is powered by a Pratt & Whitney J75 turbine engine developing about 17,500 lb. thrust without afterburner and about 26,000 lb. with afterburner. The Navy Mach 2 all-weather fighter also is designed around use of a small rocket engine of several thousand pounds thrust. Armament of the F8U-3 will be all missile, either Sparrow III or the Sidewinder or a combination of the two.

engineering grades with a maximum of $19,000 a year. The Senate version provides for 10 top administrative grades and 190 scientific and engineering grades with a maximum salary of $19,000. The Administration sought a total of 400 super grades in the administrative, scientific and engineering classifications.

In addition, the Senate deleted a House approved provision that would permit the agency to hire new scientists and engineers at a Civil Service pay Grade 7 rather than the normal Grade 5. At present, the starting salary for scientists and engineers at NACA at the maximum allowed under Grade 5 is $4,480 as compared with $4,492 paid as a starting salary to common laborers.

Senate Deletion

The Senate also deleted a provision approved by the House that would authorize the transfer of related functions of other agencies to the new space urgency.

By deleting this provision, backers of the Administration proposals say any transfers would have to be handled under the Reorganization Act and that, because of the lack of time, Congress could take no action on transfers until the next session.

Because of strong industry opposition, the Senate deleted, during debate on the floor, the section on patent rights so that it could receive further consideration in the conference committee. The House already has approved a similar section.

The section provides that any invention or discovery made on space projects belonged to the space agency unless waived. If waived, the agency still would retain the right to license others to use the invention or discovery in carrying out the functions of the Space Act.

Other differences between the two bills include:

- **House gave the agency authority** to proceed on construction or expansion projects of up to $250,000 without prior authority, while the Senate version, to the contrary, requires authorization and an appropriation before work can begin.
- **House vested complete control of** the space program in the civilian agency and directed it to cooperate with the Defense Department on military projects.

The Senate gave the Defense Department control of military projects and the space agency control of non-military aspects of the program.

- **House bill calls for international** cooperation in the space program through agreements negotiated or approved by the State Department. The Senate version calls for cooperation through treaty.
- **House spelled out the formation** of Military and Atomic Energy Liaison Committees and Military and Atomic Energy Application Divisions, while the Senate left the appointment of such committees to the discretion of the agency.
- **Senate bill called for a Joint** Congressional Committee, but the House deleted a similar section during debate on the floor in favor of separate committees.

Atlas Launching Pads To Cost $10 Million

Contracts for construction at Warren AFB, Wyo., Atlas ICBM launch site will be let by the end of this year, Maj. Gen. Bernard A. Schriever, head of Air Force Ballistic Missile Agency, announced at the formal groundbreaking ceremony for the $65- to $100-million base.

Army Corps of Engineers will open bids on July 8 in Cheyenne for construction of six Atlas launch pads. Successful bidder on the estimated $10 million project will be required to start work within 10 days after contract is awarded and must complete project within 420 days.

Reinforced concrete launch pads, measuring 133 x 104 ft., will have sliding roofs to protect them from weather. Included with the pads will be propellant and gas storage tanks, power substations, heating and air conditioning facilities.

Two launch operations buildings will be of reinforced concrete and earth mounded for protection.

The buildings will be constructed to include access tunnels and approximately 100 ft. of concrete retaining walls ranging in height from seven to sixteen feet.

Aim of Reorganization Bill Is Disputed

By Katherine Johnsen

Washington—Defense Secretary Neil McElroy last week clarified one of the main objectives of the President's plan for reorganization of the Defense Department. The reorganization, he said, would empower the Assistant Secretaries of Defense to dictate to the three service secretaries or to the subordinates of the service secretaries.

"Command over the secretaries is of increasing necessity for improved administration," McElroy told the Senate Armed Services Committee. He said the service secretaries "would have the full right of appeal to the Secretary of Defense."

Alternative Suggestion

Sen. Richard Russell (D.-Ga.), chairman of the Armed Services Committee, contended that the post of service secretary would become "a hollow and vain thing." He suggested an alternative of three Under Secretaries of Defense—for Army, Navy and Air Force—and elimination of the tier of seven assistant secretaries contemplated under the reorganization plan. At present, there are nine assistant secretaries.

McElroy reported that the Administration gave serious consideration to this alternative but decided against it on the grounds that "we could get better men" with the title of "secretary." He emphasized that increased authority for the offices of the assistant secretaries is of particular importance in the lower echelons of operations and administration so that the subordinates of the assistant secretaries would have clear authority to assure that Defense Department policies are executed in the military services.

Point at Issue

The point at issue is language in the reorganization measure as passed by the House providing that each of the three military services shall be "separately organized under its own secretary and shall function under the direction, authority and control of the Secretary of Defense exercised through the respective secretaries of such departments." This would place the service secretaries directly under the Secretary of Defense in the civilian command chain. An effort, sponsored by House Republican whip, Rep. Leslie Arends (R.-Ill.), to eliminate this provision was defeated 183 to 170.

The President has charged that the language creates a "legalized bottleneck" under which "frictions, delays, duplications would be given the color of legality."

After a three-way defeat in the House, the President's defense reorganization proposals were coldly received in the Senate. In addition to rejecting the President's request to eliminate the words "separately organized," the House voted these provisions over the President's vigorous opposition:

- **Authority for Congress to veto** any change in or abolition of "major" combatant functions of the services. An amendment to eliminate this provision was defeated 123 to 97.
- **Authority for the service secretaries** and Chiefs of Staff to present their individual views to Congress after first informing the Secretary of Defense. An attempt to strike out this provision was voted down 150 to 83. The issue may be resolved by the proposal of Sen. Ralph Flanders (R.-Vt.) under which the Secretary of Defense would inform the House and Senate Armed Services Committees of the minority views in the Joint Chiefs of Staff on all important matters.

The House finally passed the reorganization measure, including three provisions which the President claims would "emphasize disunity and separatism," 402 to 1. Russell predicted the Senate would pass a similar measure.

Russell Charge

At opening hearings in the Senate, Russell confronted McElroy with a declaration that delay and separatism in the Defense Department has not been due to lack of the statutory authority of the Secretary of Defense but rather the failure of the Secretary of Defense to exercise this authority.

Under questioning, USAF Gen.

Etendard IV-M Makes First Flight

First flight of naval version of Dassault Etendard IV-M was made using Snecma Atar turbojet engine developing 10,000 lb. thrust. French Navy has ordered five pre-production IV-Ms, and has indicated it intends to order a total of 75. Two prototypes have been built. Photo shows prototype No. 1 landing after first flight.

Nathan Twining, chairman of the Joint Chiefs of Staff, acknowledged that the Joint Chiefs had appointed a committee to study defense organization. But, since the Secretary of Defense subsequently directed another study, Gen. Twining said the JCS study was disregarded. The conclusion of this group, McElroy reported, was that there were "defects of organization rather than lack of authority."

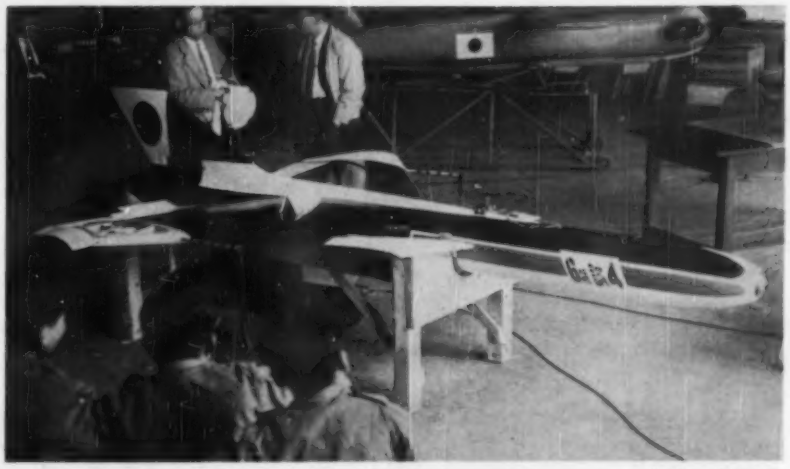
Russell said that, despite persistent prodding by Congress, former Defense Secretary Charles E. Wilson delayed decisions to eliminate duplication of effort in the missile field, notably in the case of Army's Nike and USAF's Talos. He said he is "concerned over the tendency to create the impression that there is some procedural gimmick that will provide more defense for less money. No chart can save the nation if unqualified persons pursue unwise policies."

McElroy did not foresee any substantial reduction in the requirement for defense funds except in the event of a change in the international situation. He estimated that the main accomplishment of the reorganization plan would be to "avoid intolerable increases" in defense spending. He said the main area for savings would be research and engineering. The reorganization measure establishes a Director of Defense Research and Engineering with sweeping authority over the programs of the three services. The present authority of Advanced Research Projects Agency to make research and development contracts is withdrawn and turned over to the new director. Other non-controversial provisions of the reorganization legislation include:

- **Joint Chiefs of Staff** is strengthened. The authorized size of the JCS staff is increased from 210 to 400 officers. The JCS chairman is given a vote and empowered to appoint the director of the JCS staff. The Chiefs of Staff are authorized to delegate their service duties to their Vice Chiefs of Staff.
- **Service secretaries are removed from** the line of command to unified commands. Directions to unified commanders would come directly from the Joint Chiefs of Staff and the Secretary of Defense.
- **Number of assistant secretaries** in each of the military departments is reduced from four to three.

Titan Acceptance

Air Force is ready to accept its first Titan intercontinental ballistic missile from the Martin Co.'s Denver Division. First launch of the Titan, probably to test the liquid propulsion system, will be made later this year after extensive static tests.



Japanese Ground-Test Reconnaissance Missile

Japanese Self-Defense Agency's B-3 guided reconnaissance missile, equipped with television transmission equipment, has been successfully ground-tested. Missile is 13 ft. long, 8 ft. in span, 4 ft. high and weighs 375 lb. with fuel. The B-3 is powered by a ramjet engine and can cruise at 454 mph. with a maximum ceiling of 16,500 ft. Missile, fueled with liquid propane and nitric acid, has a flight duration of 10 min. When fuel is exhausted, a ground signal releases a recovery parachute. The B-3 can be fired or catapulted from the ground or air-dropped in a target area. Flight test is scheduled for the fall.

Douglas Asks for Fund Restoration

Washington—Senate Appropriations Committee last week was urged to restore $283.4 million to the Air Force Fiscal 1959 budget cut by the House in earlier action (AW June 2, p. 22).

Air Force Secretary James H. Douglas told the committee that restoration of the cuts is essential to meet immediate objectives. Total Air Force requests, including adjustments to reflect increased cost of career incentive legislation recently enacted by Congress, is $18,654,400. The Air Force asked that the following cuts be restored:

- **$221.8 million in the** aircraft and missile procurement appropriation. Of this amount, $200 million was reduced by the House in the estimated initial spares and parts requirements and $21.8 million for procurement of small jet transport aircraft to be used in advanced navigator training and checking of electronic navigational facilities.
- **$45.1 million of the $50.1 million** the House cut from operations and maintenance estimates. This includes all of the $41 million general reduction and $4.1 million for medical care. The Air Force accepted the House cuts of $2.9 million for temporary duty travel and $2.1 million for operations and maintenance services in Germany which is to be offset by equivalent Deutschemark contributions by the Berlin Magistrat.
- **$16.5 million, which the House** directed be taken out of the aircraft and missile support appropriations and transferred to the Commerce Department as a contribution toward the expense of the Vortac program. Douglas said that, while the full amount of the program was approved, the language directing the transfer, in effect, reduced the total estimate by $16.5 million which could be made only through cuts in essential support programs.

Although the House reduced the Air Force requests by a total of $276,725,000, this was partially offset by specific increases in the missile program.

The House approved a total increase of $138 million, including $90 million for the Minuteman multi-purpose ballistic missile program and $48 million for the Hound Dog air-to-ground missile program.

Earlier, Assistant Defense Secretary W. J. McNeil told the Senate committee that the over-all Defense Department Fiscal 1959 budget request, including recent amendments, involves new obligational authority of $41.4 billion plus $485 million to be derived by transfer from revolving funds. Direct obligations amount to $43.1 billion; net expenditures, $40.4 billion.

McNeil said these over-all figures do not include any obligations or expenditures related to the amounts provided by the House in excess of budget requests.

The Fiscal 1959 Defense Department requests of major categories summarized by McNeil are:

- **Military personnel costs**, including $524 million of the $590 million net increase for increased military pay,

reaches a new total of $10.5 billion.

• **Operation and maintenance** is $9.2 billion, but this is subject to an increase of nearly $200 million to reflect the cost in the operation and maintenance appropriations of the pending bill for a civilian pay increase.

• **Major procurement and production,** $15.2 billion in new obligational authority, an increase of $700 million over what was requested in the House earlier. This includes $6.2 billion for the procurement of 2,100 aircraft, $4.1 billion in new obligational authority for the missile procurement and $2.6 billion in new authority for procurement of electronics, communications, ammunition, production equipment and facilities.

• **Military construction** for active forces, $1.7 billion.

• **Reserve components,** $1.1 billion.

• **Research and development,** $2.5 billion. This was increased by the House to $2.7 billion. McNeil said the $2.5 billion request does not include all funds scheduled for the research and development effort. He said the total obligational program for Fiscal 1959 would be in excess of $6.2 billion.

CAB Holds Hearing on Collision

Las Vegas—Question of liability for damages demanded by survivors and insurance companies of the victims of a mid-air collision on April 21, 1958, between a United Air Lines DC-7 and an F-100F from Nellis AFB was an unspoken issue in Civil Aeronautics Board hearings here on the circumstances of the accident. All parties to the hearing were aware of the presence of insurance company lawyers in the audience.

Purpose of the hearings was to establish the cause of the collision as a basis for corrective action. Formally invited parties to the hearings were USAF, United Air Lines, Air Line Pilots Assn. and Civil Aeronautics Administration. Several representatives of these groups complained to AVIATION WEEK that Oscar Bakke, director of CAB Bureau of Safety, was using the hearings as a sounding board to broadcast CAB and CAA self-justifications. After the first day of hearings, Bakke conducted the questioning of witnesses and on one occasion was himself sworn as a witness. Angry observers from some of the interested organizations argued that Bakke was asking CAA and CAB witnesses leading questions aimed at proving CAB and CAA were free of responsibility for the accident. However, prior to the hearings, a top official of the Board explained to AVIATION WEEK that both the CAA and CAB wanted to probe beyond the details of the Las Vegas accident in hopes of learning more about the basic causes of the collision hazard.

USAF and ALPA agree that both pilots involved in the collision probably conformed with Civil Air Regulations. They contend that the primary cause of the accident was reliance on the see-and-be-seen concept of traffic separation under visual flight rules (VFR) weather conditions such as existed at the time of the crash. Closure rate exceeded 600 kt. and examination of the wreckage indicates that the collision was within 40 deg. of head-on.

Air Force experts testified that under these conditions it was virtually impossible for the two pilots to see each other:

• **Each aircraft would present** a view of its minimum profile to the other.

• **On a constant bearing collision** course there would be no angular relative motion between the two to draw the attention of the pilots.

• **Rapid closure would minimize** the time available to the pilots to see each other and react in these unfavorable visibility conditions.

The DC-7 was on an instrument flight rules flight plan but in VFR weather both pilots were responsible for maintaining their separation from other aircraft. The F-100F was practicing jet penetrations on an instrument training flight with an instructor pilot in the front seat and a rated pilot student under the hood in the back seat. Instrument penetration procedure involved an automatic direction finder initial approach and let-down over commercial radio station KRAM from an altitude of 28,000 ft. Air Force procedure instructions say indicated air speed during penetration should be held at 300 kt.

Some observers feel the Air Force legal position is weakened because under Civil Air Regulations, the F-100F pilot had the additional responsibility of clearing himself visually before starting any maneuver. Others argue that the legal responsibility of both pilots for visual separation was absolute and existence of another regulation applying it only to one would have no relative responsibility.

See-and-be-seen concept of traffic separation in good weather was formally supported by CAB until the creation of Civil Air Regulations Part 424 created positive control of traffic on civil airways with separation established by air route traffic control centers. Part 424 went into effect June 15. Bakke testified that the CAB had opposed earlier imposition of positive control because of the belief that:

• **Wide arbitrary separations** would restrict the number of aircraft which could occupy civil airways at one time and thereby threaten strangulation of certain parts of the aviation industry.

• **Limited number of qualified traffic** control personnel combined with positive control in all weather would reduce the number of controls available to handle IFR traffic which CAB considered more essential.

• **CAB believes that the see-and-be-seen** concept is still valid though marginal.

Bakke said true, effective positive control will be impossible for "many years." An ALPA representative told AVIATION WEEK that Part 424 is a step in the right direction but still inadequate. ALPA considers it essential to eliminate the possibility of human error on the part of the controller and the time lag inherent in voice communications. The pilots would prefer a completely automatic system of control and communication. Bakke advocated wider use of speed limitations such as those applied now in high density traffic areas.

Some of the questions asked of witnesses by United Air Lines were aimed at determining whether:

• **Air Force pilot** followed an improper penetration procedure.

• **KRAM penetration procedure** is inherently dangerous to traffic on the civil airways on which it lies.

• **KRAM procedure was** set up without regard to hazard to airway traffic.

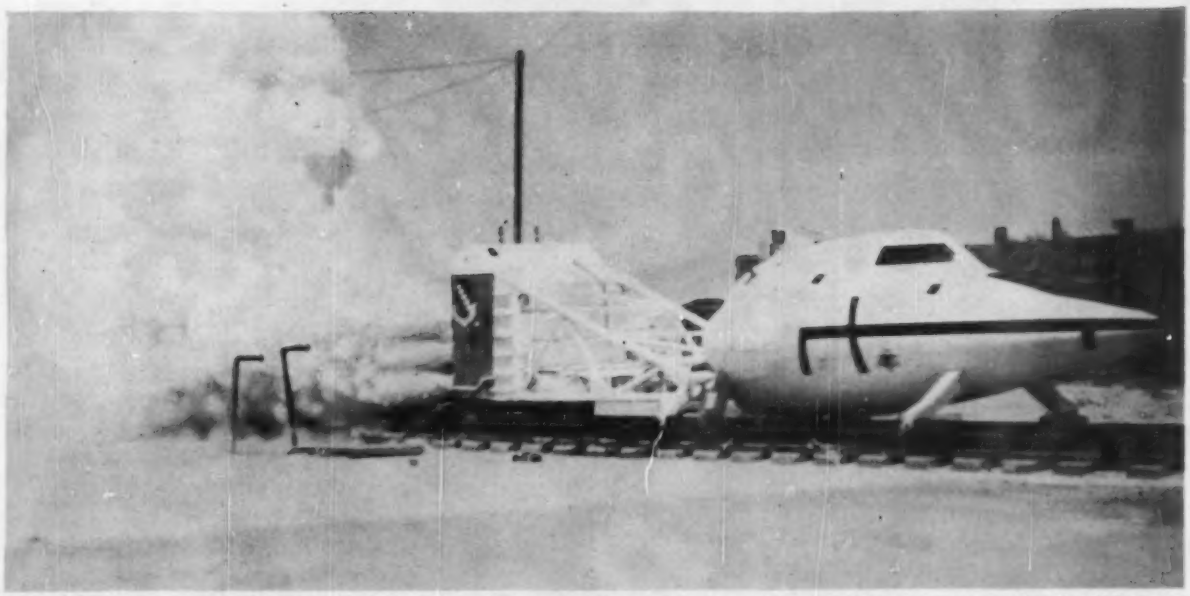
• **CAA or CAB knew of the** existence of the practice penetration procedures used by Nellis-based aircraft.

• **Any agency was negligent in allowing** the KRAM procedure to be used in controlled airspace.

• **Why airline pilots** were not informed that as many as 20 practice penetrations a day were being made through airways near Las Vegas.

Air Force canceled the KRAM procedure after the collision to await the outcome of the crash investigation. An Air Force spokesman said abandonment of the procedure was a detriment to the Nellis training program but necessary until the question of its safety is settled.

Witnesses testified that Nellis procedures were worked out in meetings between USAF officers and Las Vegas combined station and tower officials and reported to the air route traffic control at Salt Lake City. The CAA in Washington was then informed. The procedure was for use only in VFR so CAA was not required to approve or disapprove the action because the see-and-be-seen rule was applicable. However, witnesses testified that CAA did have the power to disapprove the procedure if it was considered hazardous. No action was taken and the procedure was allowed to go into use. A check over the past year indicated that a notice to airmen has never been published indicating the procedure was in use. Witnesses testified that it was considered unnecessary because of the see-and-be-seen rule.



NOSE SECTION of X-15 rocket research aircraft is propelled down rocket sled track at Air Force Flight Test Center, Edwards AFB, to test performance, under simulated flight conditions, of X-15 flight suit; ejection seat which is blown clear of aircraft by rocket thrust, and entire escape system. Sled is stripped-down F-107 frame. North American Aviation, USAF, Navy and NACA sponsored this program.

X-15 Rocket Test Facility is Started

Edwards AFB, Calif.—Construction of the X-15 rocket engine test facility is under way here. Installation, costing $400,000 and consisting of blast deflectors, static engine thrust stand, aircraft test stand, control blockhouse, impounding basin and blast wall, is expected to be completed by Aug. 1.

Engine thrust stand will hold rocket engine in horizontal position for static runups to check condition of powerplant prior to installation in aircraft and after repair and overhaul. Parameters of temperature, flow rate, pressure and vibration will also be measured. Powerplant firings will be monitored from control blockhouse, located midway between engine and aircraft test stands, and viewed with five television cameras and submarine-type periscope.

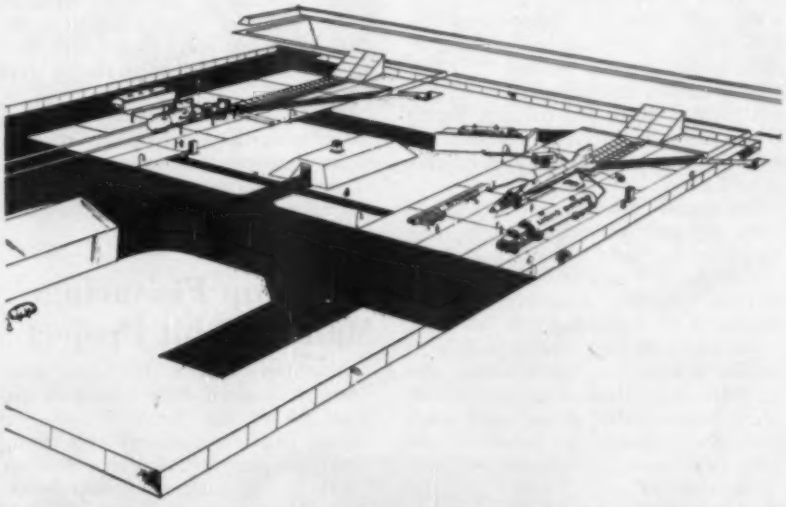
Aircraft test stand will hold the X-15 in place as rocket engines are fired. Instrumentation and calibration are similar to that in the engine test stand, but control will come from the pilot in the aircraft. Tied-down X-15 will be static-tested for preflight inspections prior to loading on a B-52 mother plane. After landing on Rogers Dry Lake, the rocket ship will be returned to stand for post-flight checkout.

Powerplant for the first X-15 flights will be two Reaction Motors XLR11 rocket engines in tandem, to be ground-tested in October when construction and instrumentation work on the facility is scheduled to be finished. Later, a more powerful Reaction Motors engine, probably XLR99, 60,000 lb. thrust unit, will be ground-tested before being installed in the X-15.

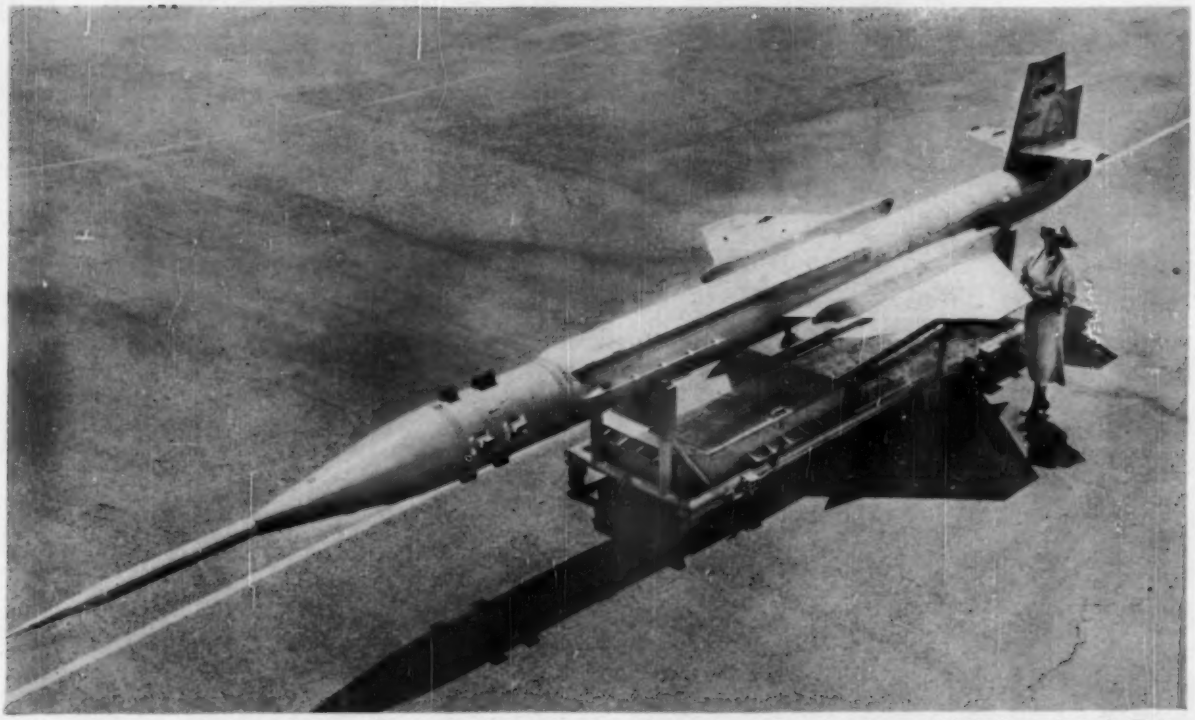
Control blockhouse, constructed of 18-in. concrete covered with three feet of earth, will protect technicians from any possible explosions. Control room inside the concrete shell uses glass fiber to minimize noise and vibration.

Systems checkout and calibration building, concrete blast deflectors, substation and a 20 x 40 ft. portable shelter for covering the engine between firings are also included in the facility. Water storage tank, holding 50,000 gal., will supply deluge and cooling systems for the test stands; an impounding basin will collect contaminated water and propellant run-off. Blast walls will shield ammonia and high-pressure gas trailers servicing the engine.

North American Aviation will operate the facility initially during contractor performance phases. As the program progresses, Air Force Flight Test Center's powerplant branch, Navy, and National Advisory Committee for Aeronautics will assume responsibility of the engine test facility.



DRAWING SHOWS how X-15 rocket engine test facility, under construction at Edwards AFB, Calif., will appear when completed. Facility will cost $400,000.



NEW VERSION of the Lockheed X-7 resembles the Q-5 drone rather than the previous X-7 versions from which both are derived. Earlier X-7 had slightly tapered wings. This version, the X-7A-3-1, has rhombic wings like Q-5, similar fin configuration to Q-5.

X-7 Ramjet Missile Delivered to USAF

Los Angeles—Lockheed Missile Systems Division has developed and delivered to Air Force a month ahead of schedule, improved version of X-7 missile to fly latest Marquardt Aircraft Co.'s high-powered ramjets for advanced interceptor missiles. Advances built into 37-ft.-long X-7A-3-1 missile, include:

- **Ability to accommodate** four different types of Marquardt ramjets.
- **Recently perfected autopilot** which responds to commands in ⅛ sec., or twice as fast as older version.
- **New camera instrumentation** to permit twice as much film coverage during entire flight, for detailed analysis.
- **Underwing boosters** to allow ground, as well as air, launches.
- **Reinforced structures** to withstand more rigorous test requirements, new speed and altitude demands.

Air launch of new version of X-7 will be from bomb bay of specially modified Boeing B-50. Following free fall drop, a pair of underwing rockets will boost missile to supersonic speed where ramjet takes over. Underwing boosters replace rear-mounted rocket unit previously used. Missile has parachute and nose spike recovery system as in older versions of X-7.

The X-7A-3-1 has been described previously as a test vehicle for the Marquardt RJ43-MA-7 ramjet engine destined for the Boeing XIM-99B Super Bomarc (AW April 7, p. 30).

Configuration of the new version closely resembles the Q-5 drone, which was developed from the X-7 and which will be built for the Army under the name Kingfisher. Both the Q-5 and X-7A-3 have rhombic wing planforms in contrast to the slightly tapered wings of the earlier X-7 models. The Q-5 also uses rocket boosters under the wings.

Fairings on the wing are for the new camera installation. Formerly the X-7 carried cameras in much smaller pods at the wingtips. Nose projections are small protective boxes placed over sensing probes to protect them during shipping.

The aerial on the fuselage ahead of the wing may have been placed there to avoid interference from ionization left in the wake of the vehicle. It undoubtedly relates to some form of command guidance.

Northrop Financing Man-in-Orbit Project

Northrop Aircraft, Inc., has designated its manned space laboratory program (AW May 5, p. 37) Project Broom (Ballistic Recovery of Orbiting Man). Pending an Air Force decision, Northrop will continue Project Broom studies on its own initiative. Proposal is based on existing rocket propulsion systems to place a capsule in orbit.

Missiles Cost U. S. $1.3 Billion Annually

Los Angeles—Better organization and management of weapon systems to compress time is an absolute prerequisite for successful completion of the ballistic missile program, Maj. Gen. W. T. Thurman, Deputy Director for Procurement and Production, Air Materiel Command, told 1,200 members of the American Institute of Industrial Engineers.

Speaking on cost of ballistic missiles program, Gen. Thurman said the U.S. is spending more than $1.3 billion annually for airframes, engines, guidance systems, nose cones, and many other supporting components which will eventually result in an operational missile weapon system. This means the nation is spending at rate of $3 million every day of the year, Gen. Thurman said. Money is distributed to some 15 major prime contractors, also to about 60 secondary primes who conduct research studies, develop new fuels, design smaller subsystems.

New facilities for the ballistic missile program costing more than $320 million, financed by both Air Force (about $195 million) and industry (about $125 million) are already in being. "Quality, then, rather than quantity, must be our watchword for the future," Thurman declared.

"With the ever-increasing complex-

ity of our scientific and technological developments, we can no longer afford to have many replacement and spare parts in stock for our missiles. These same parts, which we are producing today, may be obsolete by the time the missile is ready to be launched. That is why we must continuously strive for newer and better methods and technologies, for improved materials and equipment," Gen. Thurman said.

News Digest

Air Force plans to fly two F-104Bs to Europe within the immediate future for a tour of NATO countries. The F-104 is one of two U.S. fighters being seriously considered by the West German government. Other aircraft under study is Grumman's F11F-1F.

Trans World Airlines is furloughing 1,000 employes in a cost-cutting move resulting from a loss of $14,094,000 during the first five months of 1958. The airline's 26 officers will take a 10% salary cut.

Maj. Alford J. (Al) Williams, pioneer speed and acrobatic pilot, died June 15, at Elizabeth City, N. C., after a long illness. First man to fly 300 mi. an hour, Maj. Williams retired from the U.S. Marine Corps in 1940 and was aviation editor of Scripps-Howard newspapers until 1949. Maj. Williams was an expert on flight safety, pioneering in inverted flight recovery techniques. In 1929, Maj. Williams was awarded the Distinguished Flying Cross for his achievements in high-speed flight.

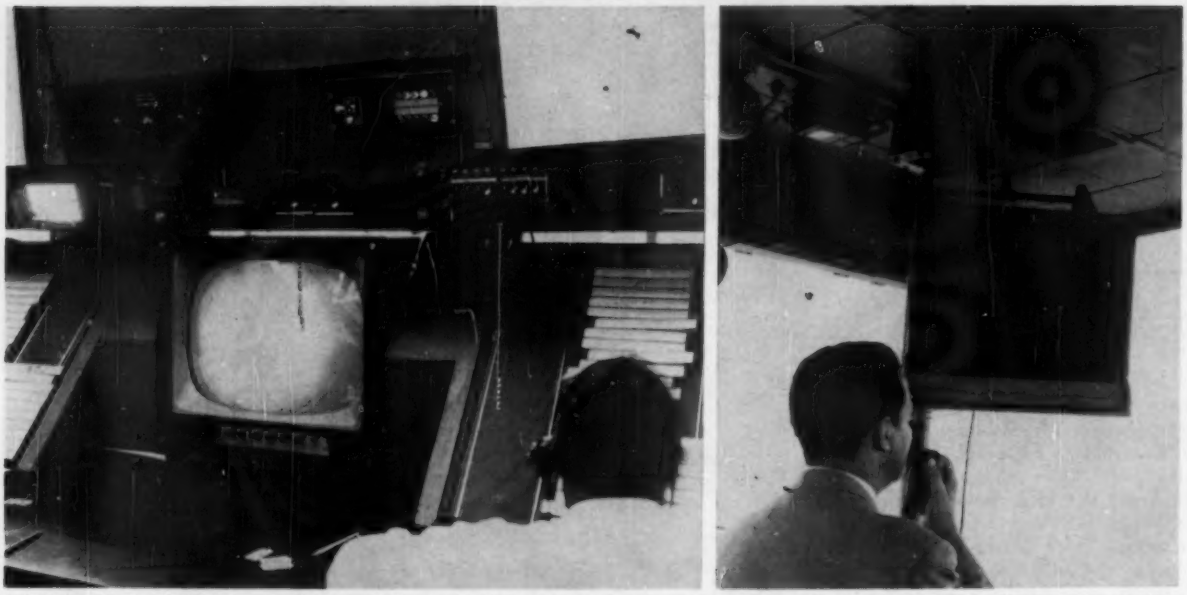
Genesys Corp., specializing in the field of electronics, has been formed as a wholly-owned subsidiary of Chance Vought, Inc., Dallas, Tex. Based in Los Angeles, Calif., Genesys Corp. will concentrate on design, development and manufacture of advanced control computer systems, components and allied products, with major emphasis on commercial and industrial applications.

Bell Aircraft Corp.'s X-14 experimental jet VTOL has performed a full in-flight transitional cycle. Vehicle rose vertically from the ground, accelerated into forward flight and returned to hover over the starting point before landing vertically in conventional horizontal attitude.

Nigeria is considering establishment of a national airline, according to Samuel Akintola, Minister of Communications and Aviation who is in London for preliminary financial talks. He said he is discussing the plan with BEA and BOAC.

Fairchild Goose Has Delta Wing

First photos of Fairchild Goose, USAF's SM-73 ground-launched diversionary missile, is launched at Air Force Missile Test Center, Cape Canaveral, Fla. Delta-winged, airbreathing Goose is designed to be launched ahead of, or with Strategic Air Command Missiles or manned bombers so as to act as a decoy, confusing enemy air defense systems. Fairchild Engine and Airplane Corp.'s Aircraft Division, Hagerstown, Md., is prime contractor for the long range missile, which is powered by a Fairchild J83 producing about 2,000 lb. thrust.



SPANRAD display (left) is mounted in proximity to the flight progress boards at the Indianapolis Air Route Traffic Control Center. The radar controller coordinates work by interphone with the flight progress strip controller. Experimental 17-in. television radar indicator (right) is fitted with a light trap to reduce reflection. The indicator is installed in Indianapolis tower cab.

CAA Unit Drafts Jet Traffic Procedures

Ground rules for jet operations evolve from study at research center; priority treatment is ruled out.

By Robert H. Cook

Indianapolis—Civil Aeronautics Administration air traffic experts have evolved tentative ground rules for the safe operation of jet transports over the next five years from findings gained through a dynamic simulation program at CAA's Technical Development Center here.

Preliminary evaluation of thousands of hours of operation of the TDC simulator, a laboratory device combining optical, mechanical and electronic equipment with the human factor in air control (AW Oct. 29, 1956, p. 40), indicates that jets will have to conform to many new operational procedures if air safety is to be preserved and airport acceptance rates maintained at a high level. Priority treatment of any type will not be practical, says TDC, which suggests the following procedures for jets:

• **"Drift up" technique used by jets** to gain optimum altitude for peak efficiency will have to be abandoned in order to avoid ruling out the use of altitude separation between such aircraft in the air traffic control pattern.

Simulator studies indicate that a happy medium, combining a maximum of safety with a minimum of fuel penalty, could be obtained through the use of an accelerated climb procedure. On a typical coast-to-coast flight, the use of a single 4,000 ft. step to altitude would inflict a 3% fuel penalty over the "drift up" technique. Using three 2,000 ft. steps, the penalty would be less than 2% with the aircraft closer to its optimum altitude. TDC says the fuel penalty for a typical new jet will be about 1,000 lb. per hour for each 4,000 ft. deviation from the optimum altitude.

• **Unrestricted climbs on course** in high density areas will have to be sacrificed in the interest of safety with such alternatives as flying at low altitude until clear of all area restrictions or climbing out in an opposite direction to the planned course. The latter method is now being used by aircraft in Los Angeles to avoid mountains and incoming traffic from the East. Either method will impose an economic penalty since it will cost an average of $900 per hour to operate the typical jet airliner.

Low-altitude departure lanes will have to be as short and as high as possible; air speeds should remain constant with little variation and detours kept as small as possible to avoid excessive penalties in fuel and flight times, according to the development center. Simulator studies show that a detour of as little as 50 mi. would impose a loss of seven minutes flight time and a fuel penalty of 1,430 lb.

• **Scarcity of suitable operating lanes** will further highlight the cost of jet flights which are expected to adopt the 20,000-25,000 ft. altitude range most suited to their design. Inherent errors in current altimeters will tend to limit these lanes, indicating the need for 2,000 ft. vertical separation at altitudes above 29,000 ft., thus reflecting a 50% reduction in available cruising levels. Spacing of ground navigational aids (Vortac) 200 or more miles apart for high-altitude airways requires airlanes at least 30 mi. wide to allow for an increased chance of error, thus limiting the possibility of providing parallel lanes to separate civil jets from each other.

• **Jet holding patterns should be** at low altitude instead of high altitude and preference landings formerly considered necessary for jet transports probably will not be needed. TDC regards this as a "terrific problem," pointing out that 132 sq. mi. of air space are now needed for a one minute low-altitude pattern. A two minute pattern at 30,000 ft. consumes 1,245 sq. mi., or just three miles less than the total area of Rhode Island.

Simulator tests, using a 100% sample of jet aircraft fed into the Chicago area from altitudes of 20,000, 10,000 and 4,000 ft. indicated that acceptance rates would be respectively 23, 33 and 34 per hour. Major reason for the increased rate at low altitude is the shorter approach path as compared with the 40 mi. needed to descend a typical jet from 20,000 ft. The Technical Development Center believes the decrease in delays would more than compensate for any increase of fuel consumption at low altitudes.

• **Path stretching** may be a "short cut" to approach control of jets. Simulation studies have included use of special spacing tables by radar controllers to show the proper amount of separation needed at the beginning of the final approach path to ensure a positive separation of three miles all the way down the final approach. Studies of suitable traffic patterns also pointed out the need for space for a base long let down for precise path stretching operations prior to final approach.

• **Velocity control** during the last 100 mi. of flight to absorb most of the delay en route also is being explored by TDC. Basically, this is a pre-assigned landing reservation determined by the controller using a special slide rule computer known as ASCON (arrival scheduling control).

Optimum speed and deceleration program for each aircraft is fed into ASCON which computes the time the aircraft would arrive if it were the only one in the area. The controller then checks the list of landing reservations and reserves the first available landing time. The computer then indicates the ground speed to be made by the aircraft to enable an on-time arrival.

"Hope for the immediate future" in handling high speed jets, is an improved radar display and electronic data processing system, TDC spokesmen say.

Most promising of the displays undergoing tests is the SCANRAD (Superimposed Panoramic Radar Display) scan conversion radar-TV produced by the Intercontinental Electronics Corp., Mineola, L. I., N. Y. This combination allows daylight viewing of radar display and operations board image on the same screen. Heart of the unit is a controllable video transformation tube that can retain radar targets on the display for up to 30 min. with a trailing blip indicating the past track of the aircraft and, therefore, the intended course.

Tests indicate that the tube has a life expectancy of 1,000 hr. as compared with the maximum eight hours for tubes in the old Navy VG radars now in use.

SCANRAD not only provides the more brilliant display needed in both air traffic control centers and tower cabs but can readily be adapted to other types of display, large screen projection or transmission from one control center to another by microwave or coaxial cable.

CAA last year procured a number of these sets for installation in the Cleveland and Indianapolis traffic control centers and the four control towers at Indianapolis, Midway, Idlewild and Washington, D. C.

The use of a Kelvin-Hughes photo projection system also is being investigated by the development center. This unit employs an overhead camera in the plotting room. The camera takes a picture, develops it in 10 sec. for televising to a radar screen. TDC says it is possible to cut this time to only four seconds.

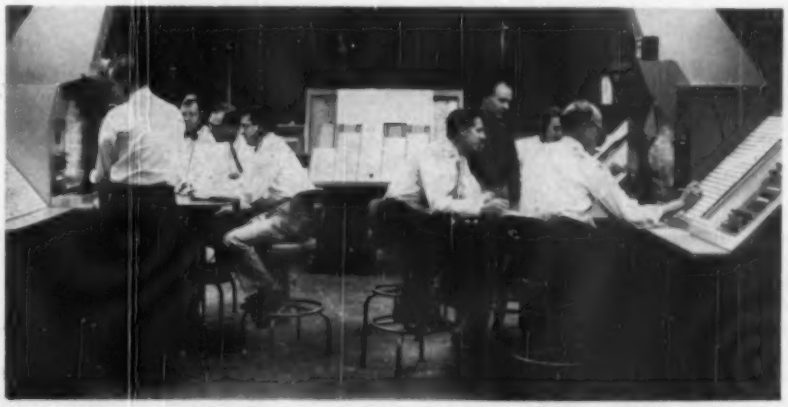
The center is exploring time share displays to permit data from more than one radar to be placed on one indicator simultaneously and the use of radar devices such as light guns to identify targets between control positions.

Work on automatic data processing has gone through a simulator phase, and TDC has been utilizing an IBM 650 Remac computer to train a group of New York City traffic controllers for the past six months.

A Univac computer is scheduled for installation in that city's traffic control center this month, and in Washington by July or August. Five other computers will be placed in New York-Washington-Chicago "Golden Triangle" area by next year, according to Technical Development Center Director Don Stuart.

Computer use in data processing is expected to save 50% of the time formerly spent preparing flight strips. Time to handle one flight has dropped from four minutes to 20 sec. in TDC tests. Volume of the task is indicated by a daily average of 7,000 such strips filed at the Indianapolis center. Major portion of the funds for testing and development of the prototype system have come from the Airways Modernization Board which will later use the findings as the basis for a more advanced study, Stuart said.

CONTROLLERS use simulated radar scopes to study terminal area control. View screens show radar sweep superimposed on a panoramic display of traffic area with moving dots of light representing aircraft. Display is televised from an adjacent room.



SIMULATOR project shows air route control room layout, using two SPANRAD displays.

Military Hedges Support of Agency Bill

Washington—Formal support by the military and government for the creation of an all-embracing independent Federal Aviation Agency was barred last week by two controversial issues. They are:

• **Civil Aeronautics Board scope** of power. The Board last week made a strong bid to retain its present authority to make safety regulations, allocate airspace and hear appeals on regulations. The White House, however, stood pat in its position that the Board should be stripped of these powers. President Eisenhower can be expected to veto any bill that fails to provide for the transfer of such authority from the Board to the proposed agency.

• **Military participation.** Defense Department wants a joint partnership of military and civil elements within the staff of the proposed agency. Controversy lies in congressional fear of military dominance versus military concern that the agency will lack sufficient power to handle traffic under emergency or wartime conditions.

Other differences of opinion on the proposed agency were brought out during last week's hearings before a Senate Aviation Subcommittee. But most observers feel that they are minor in nature and will be resolved quickly because of a general eagerness to get the agency into being before Congress adjourns.

Presidential Support

The pending bill which would amend the Civil Aeronautics Act of 1938 is sponsored by the subcommittee's chairman, Sen. A. S. Mike Monroney (D.-Okla.) and 32 other senators (AW June 9, p. 26). President Eisenhower lent his support to the bill through a special message to Congress urging passage of the legislation.

Civil Aeronautics Board Chairman James Durfee, accompanied by three board members, told the subcommittee during last week's hearings that the Board unanimously supported the single agency concept. He made it clear, however, that the Board was violently opposed to any changes in the act that would weaken the Board's present authority in various regulatory and safety matters.

He backed his position with an urgent appeal that Congress resist any move to transfer the Board's quasi-legislative rule-making functions from the legislative to the executive branch of the government and warned:

"Let there be no mistake about this—the Federal Aviation Agency, as proposed (in the Monroney bill) is not an independent agency answerable to the Congress. Its only independence is from the Secretary of Commerce; it would be part of the executive branch of the government."

Durfee supported a single aviation agency designed to handle "research, development, maintenance and operation of aviation facilities and services relating to air traffic control." Although his definition describes the Civil Aeronautics Administration as it exists today, he did emphasize that the agency should consist of civil and military personnel and added:

"It is clear, however, that artificial separation of the operations function and the research and development function cannot continue. These are the real pieces of divided authority which need a major and immediate welding job."

'Independent Tribunal'

He envisioned the proposed agency as a group responsible for the operational and managerial aspects of aviation. On the other hand, he defined CAB as an "independent tribunal directly responsible to Congress" which has the responsibility for the "formulation of basic regulatory policy" to maintain the "delicate balancing of rights and interests." He added:

"In our judgment, rule making should not be a major responsibility of the agency charged with the management of facilities and services."

Durfee warned that allocation of airspace by the agency's administrator would result in the control of airspace by the Air Coordinating Committee.

His position with respect to the Board's retaining allocation of airspace, rule-making and right of appeal drew no support from other witnesses representing government and the military services. Most observers feel that Congress is not likely to be sympathetic to the Board's plea and will willingly shift responsibility for such aviation activities to the executive branch.

Pyle Testimony

Civil Aeronautics Administrator James Pyle urged the transfer of safety regulations to the new agency and argued against any provision that would permit the CAB to review safety rules, regulations and minimum standards issued by the agency's administrator.

Pyle also told the subcommittee he would like to see a strengthening and a clearer definition of the administrator's authority. A long-term supporter of more stringent safety regulations, Pyle called for changes that would put more teeth into current rules. Pyle is considered the leading contender to head the new agency once the bill is passed.

Malcolm A. MacIntyre, Air Force Undersecretary, told the subcommittee that the bill "falls short of the joint staffing which is felt by the Department of Defense to be necessary."

He added:

"To assure adequate military participation . . . it is suggested that the Secretary of Defense and the administrator could work out a mutually satisfactory proposed table of organization during the period between passage of the Monroney Bill and its effective date."

MacIntyre also called for the creation of a deputy administrator post to be filled by presidential appointment with Senate approval which, he said, would leave "open the possibility that, with Senate approval, an active military officer could serve as a top official of the agency."

MacIntyre also opposed provisions covering Board review of regulations. He urged that personnel now assigned to CAA's offices of air traffic control and air navigation facilities be placed in a "career service when transferred to the new agency." He said such a service should be similar to the Coast Guard so that agency personnel engaged in key functions in peacetime would continue at their posts "uninterrupted" in the event of war or emergency conditions.

Quesada Proposes Changes

Elwood Quesada, special presidential aide, outlined these recommended changes in the Monroney bill:

• **New agency must have "paramount"** authority over allocation of airspace. In the control of airspace, full recognition must be given to national defense interests.

• **Active participation by** military personnel is essential to management functions common to civil and military needs.

• **Safety rule making authority** must rest in the new agency to eliminate loss of time, duplication and confusion.

• **Regulations should be issued** by the agency and appeals therefrom should be made directly to the courts. Accident investigations should be handled by the agency. CAB should make determinations as to the probable cause of accidents based upon all evidence. The Board also should hear appeals from actions of the agency in revoking airmen or aircraft certificates.

• **Legislation should include** provisions designed to assure "the stability and continued service of essential personnel in a military emergency."

Boeing 707, Soviet Tu-104 Displayed at Vancouver

U. S. and Russian entries in the jet transport field appear together for the first time at the British Columbia Centennial Aviation Show at Vancouver International Airport. Boeing 707 in foreground is third production airplane completed at company's Renton, Wash., plant. At rear is a Soviet Tu-104. Both aircraft have swept wings. Tu-104 is powered by two Mikulin M-209 turbojet engines reportedly producing 14,850 lb. thrust each. The 707 is powered by four Pratt & Whitney JT3C-1 (J57) turbojets, each equipped with sound suppressors and thrust reversers. Engines are rated at 10,500 lb. thrust each.

Northwest Plans to Buy DC-8, Electra

By L. L. Doty

Washington—Details of Northwest Airlines jet transport program involving the purchase of five DC-8 turbojets and 10 Lockheed Electra turboprops were revealed here last week with the filing of initial exhibits in the Civil Aeronautics Board New York-San Francisco nonstop case.

Although contracts with Douglas and Lockheed have not been formally signed, Northwest is resting its case in the Board's proceedings on plans for the ultimate purchase of the two turbine fleets.

Here is the scheduled delivery Northwest will count on to make its entry into jet competition:

• **Delivery of the Electras** will begin in July, 1959, and will continue through December when the final three of 10 airplanes will be delivered. The airline has an option on two Electras scheduled for delivery in March and April of 1960.

• **First of the five DC-8s** will be delivered in March, 1960. Fifth aircraft will be delivered in September. The airline has taken an option on an additional four of the turbojets for delivery in December, 1960, and March, June and July, 1961.

New Version of DC-8

Contract negotiations between Northwest and Douglas resulted in a new version of the DC-8 that increases the takeoff thrust and takeoff gross weight of the airplane through the replacement of the JT4A-3 turbojet with the JT4A-10, an advanced version of the J75 with a thrust of approximately 18,000 lb.

Maximum gross weight of the new version is 310,000 lb. Maximum landing gross weight is 199,500 lb., or 5,500 lb. more than standard models, and maximum zero fuel gross weight is 175,900 lb. Manufacturer's empty weight has been set at 123,856 lb.

Based on a 42 first-class and 84 tourist-class passenger configuration, space limit payload will be 34,690 lb. with a weight limit payload of 42,400 lb.

Fuel capacity will be 23,307 gal. The increase of fuel capacity in the new model by 1,380 gal. has been made possible by the installation of fuel tanks in a new wing leading edge to fuselage fillet. The extended range permits nonstop flights up to 6,800 mi.

The new version is identical in dimensions to earlier models.

In planning the interior of the DC-8, Northwest has emphasized flexibility in the arrangement of seats. Seat tracks are designed to permit the installation of four, five or six abreast seats at various seat pitch angles varying as little as one inch.

Although separate galleys, coat compartments and lavatories in each compartment are standard on all DC-8 aircraft, Northwest has made provisions for the installation of a passenger lounge in the forward compartment and a third lavatory in the aft compartment.

Bulkhead separating the first-class and tourist passengers can be installed at any location in the center cabin to increase or decrease the capacity of either compartment.

Separate passenger service will be provided each class of travel. Control of cabin lighting, public address and stewardess call can be switched to either the forward or aft stewardess station.

Configuration Flexibility

Flexibility of passenger configuration will allow Northwest to install from 94 to 102 seats in a four abreast arrangement, 118 to 128 seats in a five abreast configuration or 139 to 151 seats in a six abreast grouping. The latter configuration will allow a seat spacing of 40 to 35 inches respectively.

The ratio of tourist to first class passengers can be varied from 1:1 to 1:3.

Northwest estimates its scheduled flight times on nonstop flights, at 30,000 ft. between San Francisco and New York will be:

• **Eastbound summer flights** will be scheduled at 4:46 hours, westbound at 5:19 hours for an average of 5:02 hours.

• **Winter flights will operate** eastbound at 4:46 hours, westbound at 5:39 hours for a 5:12 average. Yearly average will be 5:07. Times are block-to-block times based on a Mach divergence cruise condition.

In its presentation to the Board in the New York-San Francisco nonstop case, Northwest proposed two nonstop DC-8 flights daily in each direction. The airline estimated it would operate 10,348 scheduled miles daily with the turbojet transports at a 97% performance factor.

Seat Mile Estimate

Annual available seat miles are estimated at 153,876 first class and 307,752 tourist for a total of 461,628. Annual available ton miles between the two coastal cities with the DC-8 is set at 63,547.

Yield per passenger mile is estimated at 4.67 cents and 25 cents per mile and property ton mile. Annual revenues are estimated at $12.5 million of which $11 million would be derived from passengers.

The exhibit shows that, on a fully allocated cost basis, Northwest would earn $1.9 million net operating income per year.

The total operating expenses covering the DC-8 service on the transcontinental route are set by the carrier at $10.6 million with flying operations expense amounting to $3.6 million and maintenance totaling $2.4 million annually.

The airline has allocated $1.3 million of total operating expenses to promotion and sales and $1.38 million for depreciation and amortization of which $1.28 million will be chargeable to flight depreciation.

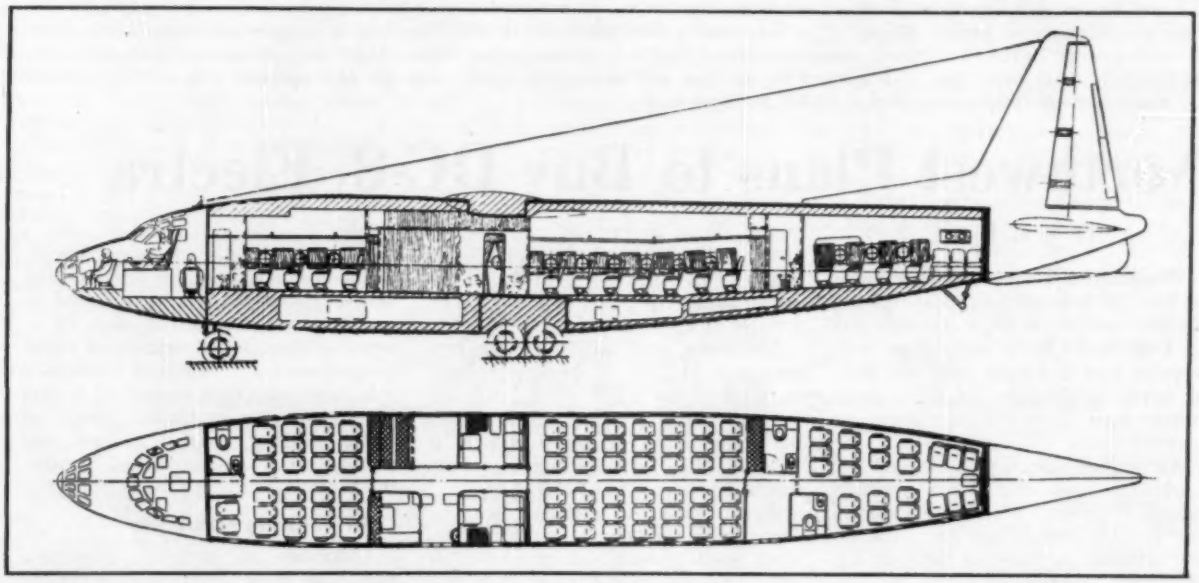
Operating Expenses

Direct aircraft operating expenses of the DC-8 flight assigned to the route will total 178.31 cents per plane mile. Included in this amount is 95.39 cents per plane mile for flying operations, 40.15 cents for direct aircraft maintenance, 34.34 cents for flight depreciation and 7.93 cents per plane mile for contingencies.

In its presentation to the Board, Northwest estimated that no more than 8% of the present European market would be diverted from the San Francisco-New York route by polar routes (AW May 19, p. 38).

Airline Forecast

The airline forecasts that frequency of service through the New York gateway will continue to be a major factor in controlling traffic routings to Europe. It adds that the operation of jet aircraft on the San Francisco-New York-Europe routes will minimize the hours saved by a service over the polar route.



INTERIOR of Soviet An-10A four-turboprop transport accommodates 100 passengers, compared with 84-seat capacity of An-10.

Soviets Increase An-10's Load Capacity

Moscow—Russia's recently-introduced 100-passenger An-10A four-engine turboprop features several major changes in interior arrangement and expanded revenue potential as compared with the early 84-passenger An-10 (AW Oct. 14, p. 43).

Designer O. K. Antonov estimates that the tourist-class An-10A's useful load is two and one half metric tons (5,512 lb.) greater than the earlier model, allowing the Ukraina to generate up to 27% more plane mile revenue.

Seating capacity of the An-10A tourist version also has been increased by the following methods:

- **Rear cabin bulkhead was moved back** more than six feet to permit a larger rear passenger compartment with a seating configuration of 22 as compared with the 13 seats in the An-10.
- **Two small, five-seat "salons"** were created by taking space from the wardrobe galley area and the forward part of the center passenger cabin. The An-10A thus has only 42 seats in the center cabin as compared to 46 in the An-10 model.

Seat rows have been moved closer together in the An-10A with the tourist version containing 26 seats in the forward cabin, one more than in the first class model.

Center cabin of the An-10A is designed for easy conversion to a 36-passenger, first-class configuration by removing one three-seat row from each side of the aisle and realigning the remaining rows on their fixed rails.

This main cabin is equipped with an altimeter, speed indicator and clock, features that appeal to Russian air travelers. Provision also has been made for motion picture equipment.

Sleeping accommodations have been expanded by the use of two, three-seat divans at the back of the rear passenger compartment. Separated from the compartment by a curtain, the divans convert to beds by removing the arm rest.

Airline Costs Soar in New Idlewild Unit

By Glenn Garrison

New York—Idlewild's $150 million "terminal city" development now in progress will involve a way of life as different economically as it will be operationally for most of the 39 international and domestic airlines who serve the 10-yr.-old airport.

Already the cost of living for 22 foreign flag carriers has risen spectacularly since they moved last year into plush new quarters in the $30 million international passenger center. This complex, the central International Arrivals Building with its two adjacent A 'ine Wing Buildings, now handles all international arrivals requiring clearance and all international departures except those of the two American flag overseas airlines, Pan American and TWA. The foreign carriers are quartered in the wing buildings and their departing passengers report directly to each airline's separate terminal area.

The big domestic carriers will undergo an even more basic change in their economic commitment when they begin operating from individual facilities under the "unit terminal" concept of the Idlewild development. Their investments and responsibilities will be considerably greater than at present while they operate from more or less common facilities in the old terminal building which still handles all domestic traffic and some foreign departures.

Foreign-flag airline costs have skyrocketed in the new facilities, but the carriers are getting a lot more for their money. Most wonder how they managed to operate in the older, smaller quarters.

Examples of the change:

• **British Overseas Airways Corp.** paid an annual rental of $17,000 in the old terminal, now pays a total of $195,000 in yearly rent. Space in the old building totaled 4,100 sq. ft. In the new terminal BOAC has 36,000 sq. ft. of exclusive space for which it pays $122,500. It also pays about $36,000 for 38.7% of the total public circulation area (halls, etc.) in the East Wing Building; $23,000 for the same percentage of the ramp and apron area, and $10,000 for aircraft parking spots. These are the major rent items, but exclude amortization of BOAC's investment in furnishing its own space, about $1 million. Also excluded are electrical costs, cleaning, and some other costs such as the $1.50 per passenger each airline pays for government inspection services and the 45 cents per passenger each pays for porter service.

• **Scandinavian Airlines System** paid a total of $6,610 in the old terminal for 225 sq. ft. of ticket counter space, 796 sq. ft. of station office, and a 519-sq.-ft. dispatch office. Heat and electricity were included, except for an extra $775 in electricity bills. SAS paid for teletype, air conditioning etc., which it installed itself. Cleaning costs were $2,687, bringing to $10,072 annually the airline's housing costs for everything except federal inspection and porter services.

In the new terminal, SAS will pay more than this total—approximately $10,800 for electricity alone. Excluding landing charges, inspection and porter, and a ramp cleaning charge of $6.50 per flight, SAS now pays a grand total of about $141,867 per year. Breakdown is station office, lobby and mezzanine, 9,922 sq. ft., rent, $37,704; information counter, 192 sq. ft., rent $4,944; dispatch office, 3,052 sq. ft., rent $10,972; third floor lounge, 2,217 sq. ft., rent $9,533; public circulation area, 22.8% of the total 30,151 sq. ft. in the West Wing Building, rent $21,723; aircraft ramp and apron area, 22.8% of the 389,987 sq. ft. total, rent $13,291; hall between SAS and Air France lobbies, $4,900 one-half share; cleaning charge, $27,600; paging system, $1,300.

• **KLM Royal Dutch Airlines** has incurred a 1,000% increase in housing costs in the new terminal, including all services. Rental went from about $12,000 to $115,200 annually.

• **Swissair's total** rent now is $31,260.84, up from $2,736 in the old terminal.

• **Air France** paid $4,572 for 1,012 sq. ft. of space in the old terminal. Rental for 22,550 sq. ft. of exclusive space in the new building is $79,346, and rental for non-exclusive space comes to $36,605. Additional costs include $30,360 for cleaning and $7,893 for preventive maintenance.

The shift from a centralized to decentralized terminal concept means a change in the economics of passenger service concessions such as restaurants, stores and the like, to which all passengers are exposed in the centralized terminal. Of the Port Authority's $13,818,854 gross operating revenues at Idlewild last year, $1,626,234 represented income from these services.

Only about a fifth of the airport's total traffic volume (5,193,000 passengers in 1957) will flow through the international center. Departing passengers, passing directly into airline quarters, will not be conveniently exposed to the consumer services in the International Arrivals Building, but arriving passengers will. These services include a restaurant and coffee shop. Most of the carriers have provided their own bars in passenger lounges, but so far only BOAC has attempted any other facility, a small shop selling film, cigarettes, etc. The bars, incidentally, are staffed from a pool of Brass Rail restaurant chain personnel provided by the Port Authority.

Because of the relatively small volumes of customers exposed to services in each airline's area, original agreement between the carriers and the Port Authority called for the agency to provide all eating and drinking facilities in the terminal. But in working out what the carriers wanted in the way of space, the earlier dimensions of the airline wing buildings grew—from 300 ft. to 600 ft. each in length—and the carriers wanted facilities on their own premises. Hence the individual bars.

The big U. S. carriers are in the process of building their own individual, multi-million dollar passenger facilities in the 655-acre terminal area. These are either financed by the Port Authority and amortized through the rentals, if desired, or paid for directly by the carriers. Most of these six buildings are now in initial stages of construction. Their tenants are American, Eastern, Northwest, Pan American, United and TWA. Northwest, however, plans to share its terminal with Northeast and Braniff.

These structures are big enough to support their own consumer service facilities—Eastern's, for example, will be larger than the existing Newark Airport terminal.

In addition to the huge investments they represent for the carriers, the airlines also will have the economic responsibility of operating them whereas in the centralized terminal that is the Port Authority's job.

The remaining airlines at Idlewild without their own terminals—National, for example—will either continue to use the present terminal or take space in a new multi-tenant terminal the Port Authority is considering building.

The Port Authority, of course, will retain some sources of revenue from the carriers in their own buildings. For example, the agency will charge about 20% of whatever percentage each airline gets of the income from restaurant facilities in its terminal.

But on the whole, the Port Authority's role under the new plan is a lesser one than under the present setup.

"The unit terminal concept has put upon the airlines many of the responsibilities that the airport operator had before," Port Authority Assistant Director of Aviation Marshall Kochman told AVIATION WEEK. In some respects, Kochman said, the Port Authority has "retreated" under the new concept to the position of a staff adviser to the carriers.

AIRLINE OBSERVER

► Domestic trunkline traffic continued to decline during May with load factors for the month falling to 56.35%, a 4.35 point decrease from May of last year. Monthly load factors have shown a decrease from the same month of the preceding year in 21 of the past 24 months. Revenue passenger miles for May dipped 2.5% from the previous May compared to a 1% increase reported in April. March and May of 1958 are the only two months since December, 1949, that have shown a decline in passenger miles from the same months of the preceding year.

► **Airline stocks listed on the New York Stock Exchange have shown renewed strength despite signs that second quarter results will underscore the seriousness of the current financial position of the industry. Many observers attribute buyers' interest in airline stocks to the imminence of jet transport operations, possibility of a second interim fare increase and continued optimism over the future of air travel. Common stocks of both American and Pan American, which are scheduled to be among the first U. S. carriers to begin jet operations, recently hit new 1958 highs.**

► Any relaxation of the minimum time limit ruling for ticket pick-up in the no-show control plan will draw protests from accredited travel agents. Travel agents have enjoyed a bonanza on commissions earned from pre-ticketing passengers in areas where airline city ticket offices are not conveniently available. Privately a number of airline officials fear that this "hidden cost" of the no-show plan caused by an increase in the volume of commissions paid travel agents may force some carriers to join those airlines already openly opposed to rigid enforcement of the ruling.

► **Russia claims that non-Communist airlines would jump at a chance to buy the Soviet Il-18 Moskva turboprop transport if the aircraft were offered on the world market. Soviets say the enthusiastic reaction to the Il-18 was exemplified by the Belgian delegation which recently negotiated a bilateral air agreement in Moscow. Pierre Nottet, Director General of Aeronavigation for Belgium's Ministry of Communications, was quoted as saying: "What we have seen of the beautiful Il-18 and the information we have received about it indicates that no foreign air company would refuse to buy this plane. Just like there's hardly anybody who wouldn't like to buy Soviet Sputnik III."**

► Iberia Airlines of Spain wants to expand its routes from Rome to the Middle East but has delayed action on the plan until political ties between Spain and the United Arab Republic are strengthened. Iberia also wants to extend South American routes to cover a transcontinental service from Caracas and Rio de Janeiro to Lima and from Buenos Aires to Santiago. European routes will be expanded northward to serve Oslo, Stockholm and Copenhagen.

► **Portable radios carried by passengers are having an adverse effect on VHF systems of some aircraft. Interference is caused by local oscillator in the portable receiver radiating energy. National Safety Council is recommending that cabin attendants report to captains any operation of a portable radio in flight to determine whether its use is having undesirable effects on VOR or ILS reception.**

► Future of the Assn. of Local and Territorial Airlines now appears secure. Last week, Allegheny Airlines joined the group, marking the first time a local service carrier has become a member since six dissident airlines quit the Conference of Local Service Airlines last year to form the association (AW April 1, 1957 p. 38). The action by Allegheny's president, Leslie O. Barnes, brings membership in the new organization up to seven out of 13 local service airlines. With ALTA now carrying majority representation, other local service carriers can be expected to follow Allegheny's lead.

► **Capital Airlines will pull six Constellation L-049s from service July 1 for a temporary period in a move to reduce available seat miles during anticipated summer slump in traffic. The airline's Constellation fleet totals 11.**

SHORTLINES

► **American Airlines** has proposed to the Air Line Pilots Assn., in an effort to settle the wage and work dispute between the two parties, a 10% increase in pay which would give pilots flying the Lockheed Electra turboprops approximately $22,400 annually and Boeing 707 pilots $26,939. American is prepared to introduce two daily roundtrip jet flights between San Francisco and New York in December if its application for the nonstop route is approved by the Civil Aeronautics Board. The airline indicated it would provide both first and tourist-class accommodations on the 707s.

► **Frontier Airlines** reports it carried a total of 227,600 passengers in the 12 months ending May 31. These passengers were flown over 63 million revenue passenger miles, a 17% increase in both passenger and passenger mile categories. During May, Frontier carried over 19,900 passengers 6,055,000 revenue passenger miles, a 33% increase over the same month of 1957.

► **Lockheed Aircraft Service Inc.** has received a contract for jet maintenance and overhaul training aids for American Airline's fleet of Boeing 707 turbojet and Lockheed Electra turboprop transports. The Ontario, Calif., subsidiary of Lockheed Aircraft Corp. will train American's maintenance personnel with some 30 different types of panels such as electrical systems, autopilot, air conditioning, fueling and engine rigging. American says there has been $1 million authorized for the purchase of training aids and that the Lockheed order is the largest of any placed. The training panels are manufactured by Lockheed's Special Devices Division at Pomona, Calif.

► **Ozark Air Lines'** President Laddie Hamilton has flown the Fairchild F-27 turboprop transport as part of a two-year Ozark evaluation program to select additional aircraft to supplement its present fleet. Aircraft Ozark has evaluated and flown include the F-27, the Viscount 790, the Sud Aviation Caravelle jet transport, the Allison-powered Convair 440 turboprop conversion and others. The airline indicated a decision in the selection of the plane to supplement the present fleet is expected shortly.

► **Qantas Empire Airways** has introduced a second weekly flight between Australia and Hong Kong via Manila, providing Manila with three services weekly.

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These facts merit study:

- By special arrangement, Convair has transferred to Canadair all "440" tooling to start new "540" production line.
- Seat mile cost of 1.3 to 1.5 cents.
- Low operating costs make it profitable on moderate density routes . . . has 8% more seats than "440's" in standard configuration.
- Operational flexibility: uses any moderate size airport . . . has a range of 1500 miles with 2 hrs. fuel reserves . . . climbs quickly (1400 fpm) to smooth cruise altitudes of 15-20,000 ft.
- "Eland-6" engines provide wide speed range . . . overhauls at long periods . . . sectionalized design for easier maintenance. Each engine develops 3500 eshp at take-off, allowing increase of 4100 lbs. over "440" in max gross weight. Cruise speed 325 mph at 20,000 ft.
- Aircraft is in production for the Royal Canadian Air Force . . . first deliveries, July, 1959.

The turbine-powered Canadair "540" is the newest development in a series of great aircraft—the Convair "240's", "340's" and "440's"—aircraft that have already accumulated some 6,000,000 hours of world-wide operating experience—aircraft that have proved themselves to be unmatched in their flight range for speed, efficiency and economy of operation.

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By Dr. Hugh L. Dryden
(Director, National Advisory Committee for Aeronautics)

On Jan. 27 of this year I said that in my opinion it was imperative, for the peace and welfare of the world, that the U. S. should lead in the exploration of space, and that the goal of our national space program should be the development of manned satellites and the travel of man to the moon and the nearby planets. In the months since then, it has become apparent that the course we will need to follow as we move into space is quite clear and straightforward.

As a matter of fact, the extent of our penetration into space in the next few years, using both instrumented and man-carrying craft, will depend in large measure upon how effectively we utilize knowledge already in hand, and upon how hard we work to reach the far-flung goals we have set. Except for the enormous progress made in the past 55 years toward solution of the problems of flight, we would be but little closer to the exploration of space than the dreamers of early times.

The basic components of the first successful airplane, the one Wilbur and Orville Wright flew in 1903, were the structure, the powerplants and the control system. These same components are with us today, in both manned and unmanned vehicles. They will be the basic components in tomorrow's space craft.

Any flight vehicle, no matter how many thousands of miles an hour it attains or how far into space it travels, has to start from earth and accelerate from zero speed. It will have to traverse the transonic and supersonic ranges. Its early flight will be within the atmosphere. Similarly, on its return to earth from a space flight, any vehicle will have to decelerate on re-entering the atmosphere and land at low speed.

Demands of Space

Of course, space flight requirements impose new and very difficult demands upon our technology, but what is mainly required is raising to new, very high levels, our competence in propulsion, structures and guidance and control. It may be over-simplification, but not overstatement, to say that what we must do to move into space compares to the technological advances which made possible the past transitions from wood-and-fabric to all-metal airplanes, from reciprocating engines to turbojet engines, from subsonic to supersonic speeds and from low-level to high-altitude, pressurized flight. Each of these remarkable gains in flight performance became possible because of the contributions by many men, working in many scientific and engineering disciplines.

The Congress is now considering legislation creating a National Aeronautics and Space Administration, with prospects for early adoption. This legislation follows closely the recommendations of the President, made April 2, that both aeronautical and space science activities sponsored by the U. S., except for those projects peculiar to or primarily associated with military systems and operations, be conducted under the direction of a new civilian agency built around the nucleus of the present National Advisory Committee for Aeronautics.

Since the end of World War II, the NACA has been engaged increasingly in research applicable to the problems of space flight, and has designed and constructed the special aerodynamic, structural, and propulsion facilities required for this work. Examples are high velocity guns and ballistic ranges, atmospheric entry simulators, arc wind tunnels and other high temperature facilities, rocket facilities for research on high energy fuels, etc. At the present time, nearly 50% of the NACA's basic and applied research is applied in these problem areas, directly applicable to space flight.

Dr. Hugh L. Dryden

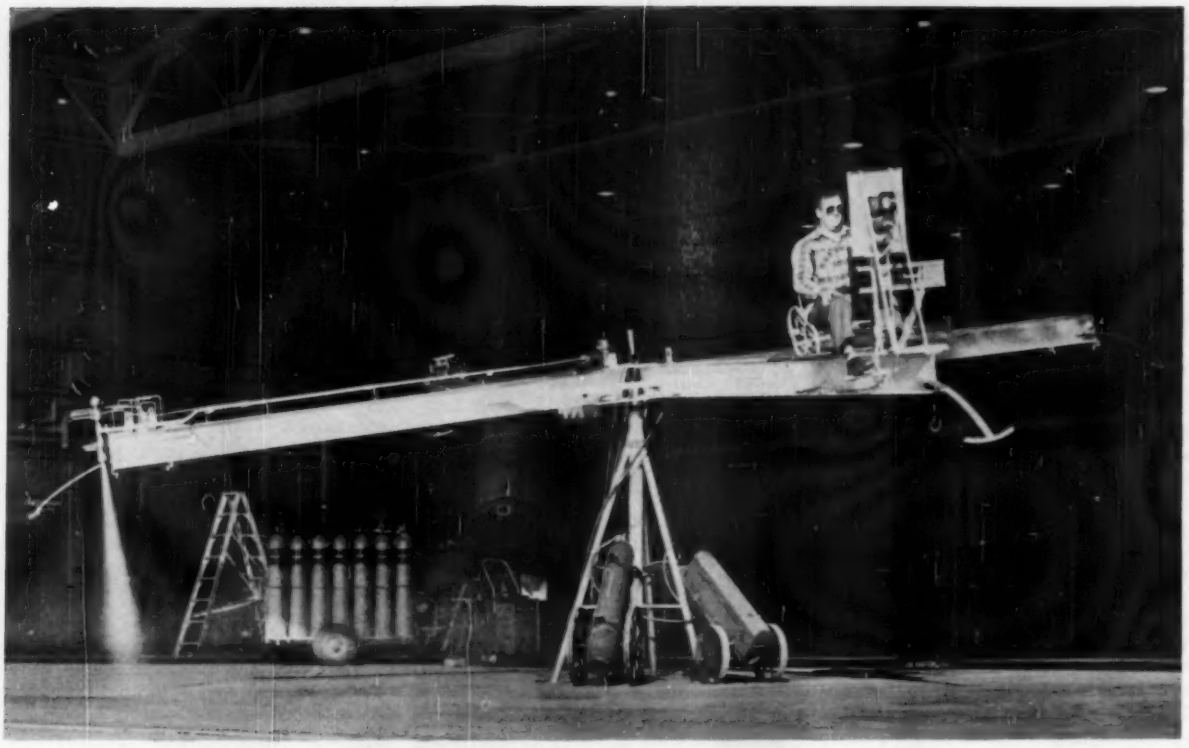
National Advisory Committee for Aeronautics is soon scheduled to evolve into the nucleus for the National Aeronautics and Space Agency which will play a vital part in planning and directing the U. S. space program. Dr. Hugh L. Dryden, NACA director and the man most likely to direct the activities of NASA, recently outlined the role the aviation industry will be called upon to provide the space effort and some of the contributions NACA already has made. Because of the importance of the speech, delivered at a meeting of the H. H. Arnold Squadron of the Air Force Assn., at Calverton, L. I., N. Y., Aviation Week is printing it in its entirety beginning on this page.

Manned Flight Study

In 1952, the NACA formally initiated studies of, and I quote, "the problems associated with manned and unmanned flight at altitudes from 50 miles up and at speeds from Mach number 10 to the velocity of escape from the earth's gravity." This work led to the design of new facilities, free flight rocket and wind tunnel research and to the X-15 research airplane project, a cooperative undertaking of the NACA, Air Force and Navy. North American is now building the airframe and Reaction Motors the rocket engine, and the X-15 is scheduled to make its first powered flights early next year.

The X-15 was not and is not described as a man-in-space project, although the Secretary of the Air Force, the Honorable James H. Douglas, has said the airplane will be capable of exceeding a mile a second in speed—more than 3,600 mph.—and 100 miles in altitude. The X-15 is a research tool designed especially for exploration of certain problems that will have to be solved before we can undertake manned flight into nearby space, with good expectations of bringing the pilot back alive. These problems include the control of the attitude of the vehicle in space in the absence of aerodynamic forces, the safe return from space to the atmosphere without destructive heating and the effect of weightlessness on the pilots for periods measured in minutes rather than seconds. Under some flight conditions, the surfaces of the X-15 will glow at red heat. I should like to emphasize what I said earlier; space flight requirements will impose new and very difficult demands upon our technology.

The NACA is also engaged in studies



Air Jets Control "Iron Cross"

Test rig for determining pilot reactions to unusual flight attitudes uses compressed air jets on three arms for flight controls. Designated "Iron Cross," device was developed by National Advisory Committee for Aeronautics and is useful in research for X-15 control system.

of satellite configurations suitable for safe re-entry at still higher speeds, for manned and unmanned flight. This work is an extension of studies on the problem of aerodynamic heating, first faced in connection with bringing long-range ballistic missiles back through the atmosphere to the target. When you consider that an ICBM is traveling at something like 15,000 mph. when it begins its descent back into the atmosphere, it isn't difficult to understand why people say it "wants to act like a meteor." The air friction can produce temperatures measured in thousands of degrees, as hot or hotter than the surface of the sun. The earth is constantly being bombarded by meteorites, big and little. What keeps all but a very few of them from hitting the earth is that they are burned up by this process of aerodynamic heating.

In 1952, one of NACA's research scientists, H. Julian Allen, developed a concept of how to shape the warhead of a ballistic missile so that the problem of aerodynamic heating could be solved. The concept, and what it accomplishes, are in one sense very simple. Until Allen's concept was proven, it was common design practice to give the warhead of a ballistic missile a needle nose to produce minimum drag. This procedure was natural enough because missile designers usually were airplane people whose objective always was to seek a minimum-drag shape.

Allen reasoned that, instead of designing the warhead in pointed fashion, it would be better to give it a very blunt shape. The result would be creation of a large pressure drag, as distinguished from friction drag. Much of the heat—as much as 99%—would be dissipated into the atmosphere by a great shock wave instead of being absorbed into the structure. Allen's concept has long since been proved valid; today every American ballistic missile, with intermediate and intercontinental range, incorporates a warhead designed in accordance with Allen's findings.

The same principles will have to be applied to make possible safe return to earth of the man-carrying satellites and space vehicles of tomorrow. There is, however, the further complication that man-carrying craft cannot be decelerated so rapidly as an ICBM warhead; the pilot couldn't stand the resulting "G" forces.

For the future, we see the need for new types of engines—nuclear-powered rockets, ion jets and perhaps others. Nuclear energy also will be used for internal power sources of the far-ranging space craft. To develop these to a state of usefulness will require large effort, and years to accomplish.

There is, however, no need for us to wait for the new engines. Our "conventional" rocket engines can be enlarged very substantially, and a rocket engine with a million pounds of thrust can be most quickly attained by use of a cluster of rockets, each producing several hundred thousand pounds. Nevertheless, development of the larger engine should be undertaken promptly.

Common Problems

To sum up, there are many problems common to aeronautics and astronautics, particularly those arising within the atmosphere on takeoff and during re-entry and recovery. There will be many other problems, some new and some old, such as guidance, communication and power sources.

No existing agency has within it all the skills and resources needed. There are no experienced astronautical engineers.

Fortunately, there are scientists and engineers experienced in rocketry, aerodynamics, guidance, communications, structures and human factors. These are men who will have to solve our space flight problems.

NACA was selected as a good foundation on which to build, because of its staff, experienced in many of the requisite fields, and of its $350 million facilities supporting work in those fields. It would be possible for the NASA to

establish new research centers for study of problems in other areas.

Such a procedure would be very costly. Trained people to accomplish the work would have to be recruited and organized into a useful staff. Almost certainly, they would have to come from scientific and engineering organizations already engaged in work of importance to the national interest. Even more critical would be the passage of months and years before the new laboratories could begin producing information vital to the space programs.

A far wiser course, I believe, will be for NASA to make effective use, on a contract basis, of teams of experts and laboratory facilities already in being. To be sure, some new research facilities will be needed by NASA at NACA's existing laboratories and at new laboratories. But most of the expanded activity of NASA will be accomplished through a greatly expanded research program to obtain assistance from groups with special competence in specific areas. Thus, special talents, experienced staffs and facilities of existing organizations can be pooled for the accelerated effort that is required.

NASA will have to develop new space vehicles. It would be possible for NASA to build the organization and the facilities for such space vehicle design and construction.

But again, such action would be very costly and much additional time would be required. It is preferable that design and construction of these space vehicles be performed, on a contract basis, at existing facilities.

I am sure that our aircraft industry is more than casually interested in who may be asked to build the space craft and rocket motors for the civilian programs of space exploration and exploitation. One obvious answer is that the organizations best qualified will get the jobs. I would make the further observation that when changing military requirements called for production of ballistic and other missiles to supplement the capabilities of the bomber, the aircraft industry demonstrated that its design and production teams were singularly qualified to develop and build missiles.

So long as the technical and production competence of the aircraft industry can keep up with the exploding needs of the national space program, the same reasons that discourage construction of new laboratories and scientific teams to perform work that can be done by in-being research organizations will apply to space craft development and construction.

The space programs we will be proposing soon for NASA accomplishment are three-fold in scope. There must be adequate research effort on space technology problems. There must be development and use of unmanned vehicles capable of carrying the desired scientific data-gathering apparatus.

Finally, there must be the development and orderly use of man-carrying vehicles in the exploration of our solar system. The three parts of our program must be skillfully integrated and coordinated. Just as rapidly as research can provide the necessary information, we should use it in developing—and launching—both automated and manned vehicles with greater performance and sophistication.

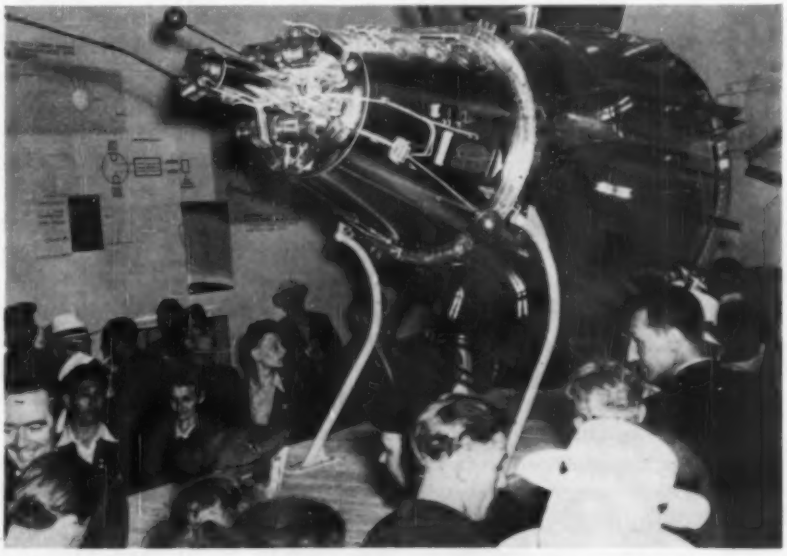
Adequate Program

I should like to emphasize the essentiality of our planning a space program that will be adequate to our needs as a nation. The size of the program and the vigor with which it is carried out must be firmly established and ratified by the Administration, the Congress and, finally, the American people. In making these decisions, we must keep in mind that today Soviet Russia is working harder than we are to achieve pre-eminence in the conquest of space.

In conclusion, I should like to quote Jimmie Doolittle, chairman of the NACA, before the Special Committee on Space and Astronautics of the Senate, last month:

"The question will inevitably and properly arise, what good will all this new information (from space) be to the people of the United States? After all, they have to pay the bill, and it is a bill that annually, for years to come, probably will be counted in the hundreds of millions of dollars. I don't know all the good it will do, and I doubt if any man alive today can give specific answers. But, in this connection, I am reminded of the story they tell about Michael Faraday, the English physicist, whose pioneering work in electro-magnetics had a profound effect upon our later understanding of electrodynamics leading to useful electric power. About a hundred years ago, Mr. Faraday is supposd to have been asked, in the British Parliament, about the value of his electro-magnetic experiments. His answer, so the story goes, was, 'I can't tell you what it'll be good for. But I'll tell you this: one of these days you'll be taxing it.'

"I can't tell you precisely what of great value will come out of our moving into space to prove the secrets of the universe. However, I have the conviction, and in this I find myself in the company of some very wise men, that a century from now, perhaps much sooner, people will say that this venturing into space that we're planning now was one of the most practical, intelligent investments of our national wealth to be found in history. If we, in the U.S., take the wisely bold action necessary to lead in exploiting the possibilities of space technology for science, all mankind will benefit. If Russia wins dominance in this completely new area; well, I think the consequences are fairly plain—probable Soviet world domination."



Russians Display Sputnik III Model

Sputnik III model is displayed in Moscow at the 1958 All-Union Industrial Exhibition. Instruments mounted on flat forward nose section include magnetometer, photo-multipliers to measure solar corpuscular radiation, and solar batteries (AW May 26, p. 29). Rod and ball sections measure concentration of positive ions. Photograph shows mechanical shutters at rear which open and close to automatically control internal satellite temperature by varying coefficient of surface radiation.

VIII

This is the eighth of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Determining Depth-Hardness of Alloy Steels

The hardenability of an alloy steel is usually measured by the depth to which the steel will harden under specific conditions of heating and cooling. One of the most conclusive methods of determining depth hardness is the end-quench hardenability test (ASTM A255). In essence, this test is as follows:

A 1-in. round specimen approximately 4 in. long is heated uniformly to the proper quenching temperature. The specimen is removed from the furnace and placed in a bracket; then a jet of water at room temperature is played on the bottom face of the specimen without touching the sides. This water jet is kept active until the entire specimen has cooled. Longitudinal flat areas are ground on opposite sides of the piece, and Rockwell C readings are taken at 1/16-in. intervals. The resulting data are plotted on graph paper, with the Rockwell C values as ordinates and distances from the quenched end as abscissae.

Experiments have shown that the points on the hardenability curve approximate the cooling rates at the centers of quenched rounds of various sizes; and that the hardness values at the centers of these rounds will correspond very closely with those shown at points on the end-quench hardenability curve.

In general it may be said that when end-quench curves for different steels approximately coincide, these steels can be treated similarly for equivalent tensile properties in sections of the same size.

A study of hardenability curves reveals that depth-hardness depends upon the amount of carbon present, the alloy content, and the grain size. Manganese, chromium, and molybdenum are the chief elements that promote depth-hardness, while nickel and silicon help to a lesser degree. It should be noted, also, that phosphorus promotes depth-hardness, while sulphur has a negative effect. In normal low-phosphorus and low-sulphur steels, the two elements neutralize each other.

Hardenability curves, and the practical application of data they yield, are the subject of intensive study by Bethlehem metallurgists. These technicians will be very glad to discuss all phases of it with you, and to give whatever help you may need in the selection, treatment, and uses of any alloy steel. Always feel free to consult with them. And please remember, too, that Bethlehem can furnish all AISI standard analyses, as well as special-analysis steels and the full range of carbon grades.

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Decompression Dangers in Space Viewed

Los Angeles—Hypoxia will be the greatest danger in decompression in biosatellites, and provisions must be made for supplying the biologic passenger (man or animal) with sufficient oxygen to survive, Eugene Konecci of Douglas Aircraft's Tulsa Division told the American Rocket Society.

Papers dealing with many facets of space flight were presented to sessions of a semiannual meeting of the American Rocket Society here, with attendance at the gathering reaching approximately 1,600 persons.

Open sessions dealt with guidance of space vehicles, flight dynamics of space vehicles, biosatellites and data on space gained from the International Geophysical Year. Other papers dealt with physics of fluids, test instrumentation, management of experimental engineering projects, liquid rocket and ramjet handling and testing, operations research applied to experimental engineering. Classified sessions dealt with missile launching operations and rocket engine systems.

Decompression Events

Konecci presented a paper on decompression events in biosatellites, covering the many effects of decompression, and the ways in which it occurs.

Best cabin, according to Konecci, is one providing "ideal environment"; that is, a good approximation of earth conditions in regard to pressure, temperature, gaseous composition of atmosphere and humidity. He termed this a "homeostatic" cabin.

Cabin decompression may be accidental, caused by exhausted atmosphere supply, mechanical failure, leaky seals, structural leaks or collision damage. Intentional decompressions may be effected to explore the outside of the cabin, perform repair work, transfer logistic supplies or to deal with emergency conditions such as formation of noxious or toxic gases.

In many cases, experiments showed that the time span of most decompression events outside of catastrophic failure or collisions, will be long enough to allow the biologic passenger to take action against hypoxia by either donning a suit, increasing pure oxygen content of atmosphere to sustain oxygen pressure in lungs required to stay conscious or alive, or by use of airlock. Also, provisions must be made against the passenger being blown out of the cabin in cases such as have happened with airliners which suffered window or door loss, leading to use of restraints of some sort under all conditions.

Dangers of meteor showers and their effects on the cabin were investigated at length, with conclusions that they pose a definite hazard for extended space trips, with dual effects of erosion and puncture. Konecci suggested use of glass fiber bottles to carry emergency oxygen supplies to reduce weight, take advantage of shatterproof qualities and low leak rate.

Dysbarism also will play a part in survival after decompression events, Konecci said, with proper physical conditioning playing an important part in performance of biologic passengers after the event.

Safety aspects recommended by Konecci included multiple wall and meteor bumper construction, self-sealing techniques, detection of leaks, warning human occupants, reserve high pressure gases (including oxygen) to delay decompression, use of full pressure suits, personnel training to emergency conditions, such devices as compartmentation, recompression chambers, pressurized seats or bunks, pressure bag, repair kits for sealing leaks.

Following Konecci's presentation, discussion arose on whether the best procedure will be to put the man in space in less than ideal environment (i.e. in pressure suits with reduced cabin pressures such as 27,500 ft. level), or to provide the ideal environment and try to retain it. Engineering aspects of providing the ideal environment were brought up including the weight penalty.

Also discussed was the possibility of providing the environment according to the mission; that is, better environment for longer missions.

Selection of biosatellite crews will be based according to criteria in a paper presented by D. W. Conover and E. N. Kemp of Convair San Diego, not on sending a man into space per se, but on sending highly capable people into a private world that is as good a substitute for their normal world as possible.

Crew selection for early biosatellites will differ greatly from crew selection for later satellites and extended space voyages, two papers indicated. Crews already have been selected for first ventures such as the X-15, as an evolutionary proposition of the right man being at the right place at the right time. Later however, this will change, paper indicated.

A second assumption was that early flights will be orbital and from a week to a month in duration.

Third assumption was that spherical, recoverable manned satellite has a high probability of being an early vehicle configuration.

Fourth assumption was that early crew sizes would be three or fewer people.

Paper indicated that many things will influence crew selection according to mission; i.e., persons with characteristics suitable for early solo trips may not be amenable to trips as members of multiple member crews.

Some selection criteria included:

- **Typical reaction** to drugs, such as antibiotics, antihistamines, tranquilizers and such; crew members may have to be their own doctors.
- **Detailed tests** for emotional stability, autonomic responsiveness.
- **Vestibular system responses.**
- **Air pressure response.**
- **Tonometric measurement** of variations in relationship of pressure within the eye and time separating high G blackout and unconsciousness.
- **Tolerance to accelerations.**
- **Thermal reactions.**

In addition to these physiological criteria, interplay of other factors which in themselves might affect performance, or which in turn may affect physiological reactions which again in turn affect performance, will have to be thoroughly investigated.

Litton Space Chamber

Use of Litton Industries' space chamber for investigations of various space flight phenomena were outlined by Siegfried Hansen, Litton director of research. Chamber has had additional facilities incorporated since it originally was put to use (AW Oct. 14, p. 62). Among these are a 17 cu. ft. uninhabited chamber which originally was built before the large chamber and used to check components of chamber suit. It now has been connected with the main chamber, although it retains its own pumping facilities and can equal the altitude performance of the large chamber either operated with it or alone. Small chamber can be brought to altitude or depressurized at will, also connected or disconnected from main chamber. Small chamber can be used as an airlock to pass into the main chamber objects which can fit within the 6-in. dia. connecting line and valve.

Another facility which will be added is an airlock which will permit at-will entrance and exit from the evacuated main chamber by the pressure-suited experimenter, to enhance over-all flexibility.

Among projects under way or forthcoming are investigation of friction phenonema in a vacuum, determination of effects of altitude on small explosive primers such as are used to initiate final stages on multi-stage rockets, tests of a 1,000 lb. magnetic

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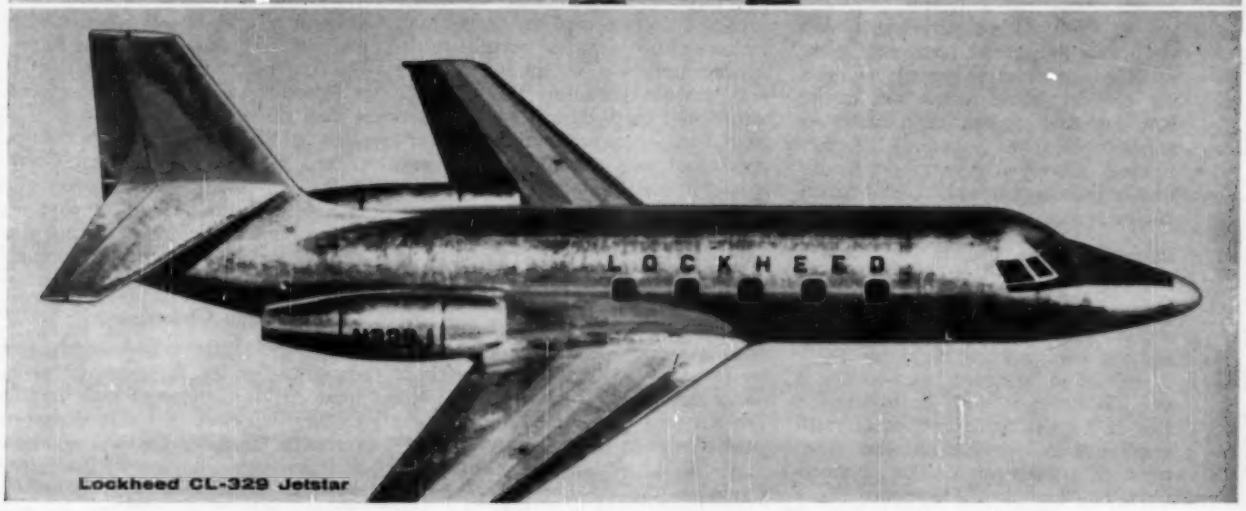

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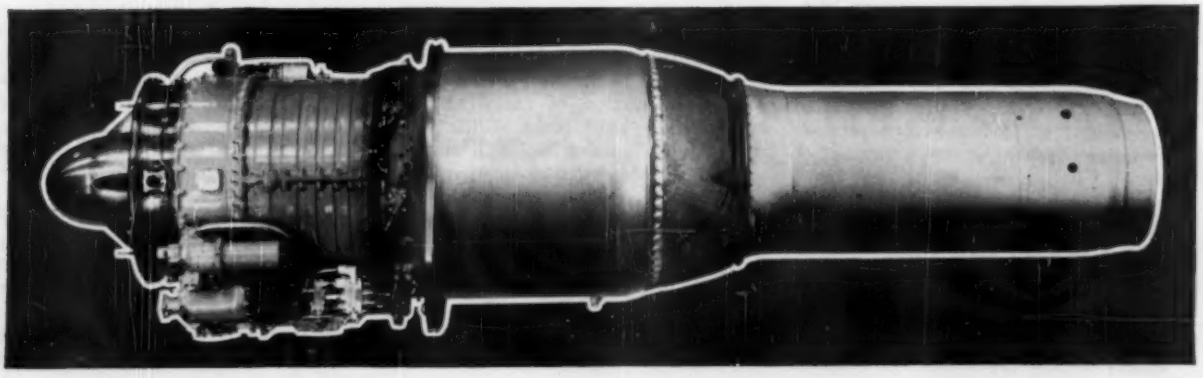

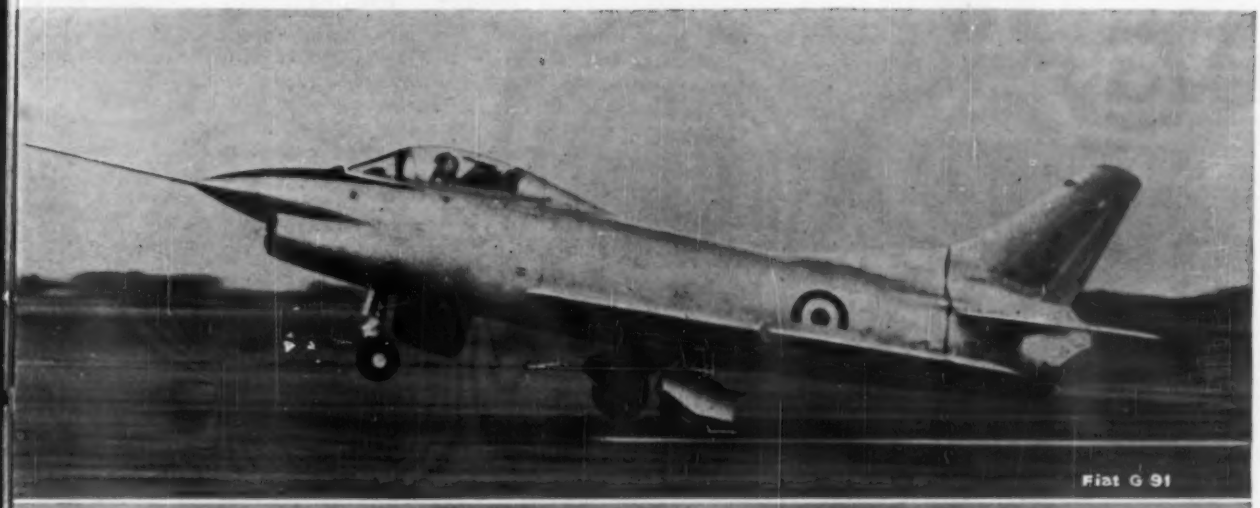

Fiat G 91

Dassault Etendard VI

Orpheus-powered Taon holds world speed record for 1,000-km closed circuit

The Bristol Orpheus goes from strength to strength. Now, an Orpheus-powered Breguet 1001 Taon holds the world speed record for the 1,000-km closed circuit. The Taon averaged 649.7 mph. This French fighter is *one* of the increasing variety of aircraft for which the Orpheus is specified.

The current Orpheus 3 is rated at 4,850 lb and has the outstanding thrust/weight ratio of almost 6:1. The Orpheus 4, the trainer version, is rated at 4,230-lb thrust; it is designed for the lowest possible fuel consumption and long life between overhauls.

Dimensions Orpheus 3: Length 75.5 in Diameter 32.4 in.

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Orpheus development continues. The latest version, the Orpheus 12, has a still higher power/weight ratio, giving 6,810-lb thrust dry, over 8,000-lb with Bristol simplified reheat.

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Fiat G 91	ITALY
Dassault Etendard VI	FRANCE
Breguet 1001 Taon	FRANCE
Hispano HA 300	SPAIN
Aerfer Leone	ITALY
Dassault Etendard IV (alternative engine)	FRANCE
Sud Aviation Baroudeur (alternative engine)	FRANCE

Executive transport/ crew-readiness trainer

Lockheed CL-329 Jetstar*	US

Trainers

Folland Gnat Trainer	UK
Fuji TIF 2	JAPAN
Fiat G 91 T	ITALY
North American Model 249 (alternative engine)*	US

Research Aircraft

Short SB-5	UK

*Production versions of the Jetstar and Model 249 are being offered with Wright TJ 37 engines. The TJ 37 is a derivative of the Orpheus, jointly developed by Bristol and Curtiss-Wright.

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shaker unit to determine derating required to permit operation in high vacuum without overheating.

Work also has been conducted with electron guns and beams against targets on bench-mounted facilities, with varying shields and other equipment replaceable for continued or changed experiments, without having to reduce altitude and open chamber between experiments.

Aeromedical space experiments also will be carried out in the chamber, including test of X-15 pressure suit. A complete medical instrumentation installation is provided in chamber suit to keep track of inhabitant's condition, currently a safety measure, but also very useful for varying experiments.

In describing a program for space biological experiments, Cmdr. George Hoover of Office of Naval Research dwelt on the main capability of, and reason for man's being in space, namely his decision-making ability when faced with unexpected events. He indicated that the best environment for man would be that which best enabled him to make decisions.

Behavior Studies

Investigations of any man to go into space, Hoover said, should include a thorough checkout of his everyday behavior, how well he makes everyday decisions in all matters and under all conditions, and factors which influence his emotional stability and psychological makeup, both extremely important in space flight.

Hoover's paper also contributed to the decision of whether the space cabin and/or environment should be the ideal (terrestrial) one or a compromise. Hoover urged the ideal environment, providing the man with the same environment he has on earth in relation to physiological aspects such as pressure, temperature and humidity.

Program for environmental studies should be divided into three parts, Hoover said: those of determining requirements for creating a proper environment, maintenance of the environment and control of the environment. Assumptions to be made are that the objective is not to find out what happens to man when exposed to space but rather to create an environment within which he can operate in space, that man must have maximum use of all his senses in order to operate efficiently, that man cannot be compromised in order to make up for deficiencies of engineering design or state of the art.

Hoover emphasized that the reason for a biological program is to determine how to permit man to operate in space, where his prime function is to make decisions based on the assumptions being reasonable. Hoover says that these things cannot be tolerated:

- **Any radiation** in excess of what is encountered on earth.
- **Weightlessness.**
- **Emotionally** stressed environment.
- **Doubtful escape system.** It must be adequate under all circumstances.

Key to the entire problem, Hoover feels, is stating the problem clearly before attempts are made to solve it.

Radiation field at altitudes above 700 mi. discovered by Explorers I and III could be composed of a plasma of free electrons or protons, a technical session of the American Rocket Society semi-annual meeting here was told by Dr. J. A. Van Allen of the State University of Iowa.

Van Allen said that if the radiation were made up of photons the energy level discovered at altitude probably could not be dissipated before reaching lower altitudes with greater intensity than has been observed at perigee of the orbit. If it is electrons, the satellite Geiger counters are probably measuring X-rays generated by their passage through the satellite shell. Van Allen surmises that the plasma is closely related to geomagnetic storms and the soft radiation detected by sounding rockets in the auroral zone.

Plasma shell is believed to be thicker at the equator than at the poles but no data has been found which is good enough to use for a firm estimate of the altitude of the top of the shell. Rough calculations indicate that the radiation may be strong enough to cause a significant amount of heating of the upper atmosphere. Van Allen indicated that studies would be made to determine how much atmospheric ionization, light and radio noise would be produced under various assumptions as to the nature of the radiation.

Results of a study of mass transfer cooling of a blunt nosed body in hypersonic flow by injection of a combustible gas into the boundary layer were delivered to a technical session by George W. Sutton of General Electric Co. Rate of injection of a gas into the boundary layer to hold a given rate of surface heating can be decreased if molecular weight of the gas is decreased. This makes hydrogen attractive but its combustibility raised questions which could not be answered out of existing knowledge. Sutton concluded that there is still a need for further investigation.

Temperatures in a hypersonic shock layer are between 4,000K and 8,000K. Forcing of a cool gas through a porous skin and into the laminar boundary layer acts in two ways to cut heat transfer into the skin:

- **It thickens** boundary layer, reducing temperature gradient within it and cuts energy flux to surface.
- **Enthalpy increase** of gas flowing through porous skin absorbs part of

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Lacrosse Nose Cones in Production

Solar Aircraft Co. is building nose cones for Martin Lacrosse guided missile at its San Diego, Calif., plant. Weapon is a close and general support missile designed for support of ground troops, supplementing air and artillery attacks in the field. Lacrosse is being built for U. S. Army and the Marine Corps. Testing is conducted at the Martin Co.'s Orlando, Fla., facility. Lacrosse is an all-weather missile powered by a solid fuel rocket motor and has an over-all length of 19.2 ft. Components of the missile's system include the launcher and a guidance system. Elements are mounted on standard Army and USMC mobile carriers. Missile can be fitted with numerous types of warheads to diversify firepower on its surface-to-surface mission. Solar Aircraft also constructs major assemblies for Atlas ICBM, Navy's Polaris and Army's Jupiter IRBM missiles.

energy flux which might otherwise go to skin.

Sutton's analysis indicates that with a small injection rate, combustion of the gas may cause temperatures higher than the ordinary stagnation temperature. With larger injection rates the flame front is pushed away from the surface and only a fraction of the combustible gas reaches the reaction zone where enough oxygen exists to support combustion. A given wall temperature can be maintained by using a larger flow rate than would be used with non-combustible gas. The proportional difference in flow rate needed with combustible and non-combustible gases decreases as the injection rate of each is increased to maintain a smaller given ratio of surface temperature to stagnation temperature.

Selection of Gases

Selection of gases with slower reaction rates also acts to lower the percentage of combustion heat transferred back into the surface because most of the combustion takes place at the edge of the boundary layer. Most of the gas is convected downstream and does not take part in the reaction.

Loren E. Bollinger and Rudolph Edse of Ohio State University told a Rocket Society audience that pre-mixed bi-propellants offer improved rocket performance because they reduce size and weight of combustion chamber. Main disadvantage is the existence of a gaseous or liquid explosive between the mixing vessel and the combustion chamber. It is possible for the flame to flash-back through the mixture to the mixing vessel with catastrophic results.

The authors showed that flame stability is reduced in a cylindrical injector tube when the laminar sublayer of the turbulent boundary layer becomes heated because of inadequate injector cooling.

Ohio State experiments show that pre-mixed gaseous hydrogen and oxygen can be used as a propellant with chamber pressures from 200 to 330 psia. and a mixture ratio ranging from stoichiometric to very fuel-rich. An envelope of unmixed oxygen was injected around the fuel mixture to prevent flash-back. Gaseous fuels were used in the experiments despite their limited practical value because of their relative ease of handling. Because of the difference in freezing and boiling temperatures it is difficult to pre-mix liquid hydrogen and liquid oxygen. The oxygen tends to crystallize out of the mixture and ignite violently due to friction heating. The authors concede that extrapolation of their data to liquid propellants may be limited since the flash-back mechanism is likely to be different; since the liquid must evaporate before combustion can begin, it probably would not occur in the boundary layer. Hypergolic fuel-oxidizer combinations could not be pre-mixed unless the chemical reaction time was long enough to allow the propellant to enter the combustion chamber before actual combustion begins. Chemical reaction should not be too troublesome with any gaseous propellants except gaseous fluorine.

The authors concluded that flow conditions in the injector inlet control flash-back from the chamber to the mixing vessel. Critical velocity gradient, a measure of the flash-back tendency, is affected adversely by heating of the injector tip. Use of pure oxygen envelope may minimize flash-back by cooling tip or by preventing flame propagation in the low energy boundary layer. Chambers of pre-mixed propellant engines had unusually small characteristic lengths.

Attitude Control

An attitude control system for space vehicles was introduced by Walter Haeussermann of Army Ballistic Missile Agency. The system would use a d.c. motor and flywheel to control rotation about each of the three axes of the vehicle. Control signal would be derived from a sun sensor, and infrared horizon sensor, a supervised gyro or a manual control. Acceleration of flywheel in one direction would rotate vehicle in the opposite direction. In order to avoid large constant friction losses, the initial angular impulse would be almost completely compensated by an expulsion or thrust device controlled by flywheel speed.

Stability of system loop could be improved by feed back of flywheel velocity or first derivative of the input attitude signal. It can be expected that after some time, flywheel speed will be reduced by eddy current damping if the vehicle travels through magnetic fields.

Haeussermann laid down five major requirements which a three-axis altitude control for a space vehicle must meet:

- **Ability to compensate** for high angular impulse exerted by last separation process.
- **Responsiveness** to automatically as well as manually generated control signals.
- **Durability** equal to the demands of continuous operation. Lifetime of the control system should at least equal to the lifetime of the space vehicle.
- **Must be capable** of operating continuously.
- **Must draw minimum power.** In small satellites it should be capable of operating on solar batteries, and in large ones should be capable of operating on nuclear source.

High Energy Solid Fuels May be Hybrids

By Michael Yaffee

Fuel chemists have broken through the bond energy limitations of the conventional CHON (carbon-hydrogen-oxygen-nitrogen) systems and, for the first time since World War II, solid rocket propellants show signs of making significant gains in energy content. The chemists have set a specific impulse of 300 as their goal and are confident that they can attain it within five years.

First batches of the new propellants, with specific impulses close to 270, will start coming out of the processing vats before then, probably within two or three years, possibly in time for the first Polaris models.

Called hybrids, these basically will be stock solid propellants, either double-base or composites, in which some of the carbon atoms are replaced by a light metal, probably boron.

The trend, however, is toward true hybridization in composition. Eventually, the new solid propellants will possess characteristics of both the double-base and composite propellants. Theoretically, the hybrids can evolve from either family; but, in all cases, their actual parentage will be completely masked by modifications.

The advent of the new high energy hybrids is considered one of the greatest advances in the development of solid propellant chemistry. It could weigh the liquids-vs.-solids balance heavily in favor of the latter; at the least, it promises to redefine the whole conventional solid combustible complex.

Both composite and double-base propellant producers are excited about it. Each believes he has an inherent advantage over the other in the race to produce the new, higher energy solids. They are moving rapidly forward with plans to prove it.

• **In Bacchus,** Utah, Hercules Powder Co. is starting construction of new research, development and production facilities for double-base propellants. Company hopes to have the first units operating before the end of the year.

• **In Marion,** Ill., Olin Mathieson Chemical Corp. is going into the second year of a scheduled four-year, $3-million expansion of its Ordill double-base facilities. Both Olin Mathieson and Hercules are paying for these projects out of their own corporate pockets.

• **In Niagara Falls,** N. Y., Olin Mathieson, apparently in an effort to protect both research flanks, is pushing ahead on the development of its recently announced (AW May 19, p. 29) solid borane composite propellant.

• **In Pittsburgh,** Pa., Callery Chemical Co., the first company to disclose that it had a solid borane fuel under development, is continuing this work. More recently, Callery signed an agreement with Thiokol Chemical Corp., opening the way for the latter's participation in this program.

• **In Denville,** N. J., Reaction Motors, a post-agreement acquisition of Thiokol, is continuing its research and development on a solid borane fuel under an Air Force contract.

Originally, this was a prime Reaction Motors contract; and Olin Mathieson, until recently a major stockholder and working partner of Reaction Motors, was engaged on one phase of this program as a subcontractor.

Now, the Air Force has rewritten Reaction Motor's solid borane contract, which in addition to research and development calls for a major increase in production over past programs, and named Thiokol as the prime contractor. Within the Thiokol complex, however, Reaction Motors Division will continue as the major contractor on this program. Other Thiokol divisions will participate in the program, and Reaction Motors plans to subcontract at least one phase of this program to Callery.

As plans for the solid borane fuel now stand, Reaction Motors Division will carry out the major share of research and development; Elkton Division will do some research; Redstone Division will do research, propellant processing and testing work; Trenton Division will do research and production; and Callery, under this subcontract, will also do production. The Air Force contract does not cover any work on the oxidizer part of the propellant.

• **At Denville,** Elkton, Huntsville and Trenton, Thiokol is pushing hard, under another program, the development of advanced oxidizers. Purportedly, these new oxidizers will increase the performance of all solid propellants. But it is the new high energy hybrids that is giving this program its greatest impetus.

• **In Sacramento,** Calif., Aerojet-General Corp., which has tied in with Stauffer Chemical for future development of boranes, is actively investigating numerous approaches to high energy hybrids and hopes to have at least one solid ready to roll in time for the Polaris.

There are a number of reasons, both scientific and business, behind this burst of activity in the solid propellant field. Some stem from a scientific substructure; others are based simply on sound business practice. In general, the reasons vary from one producer to the next. But there is one very important consideration that is common to all the current endeavors and that is the need of the military for higher energy solid rocket propellants. It is second in importance only to the demand for storable liquid propellants.

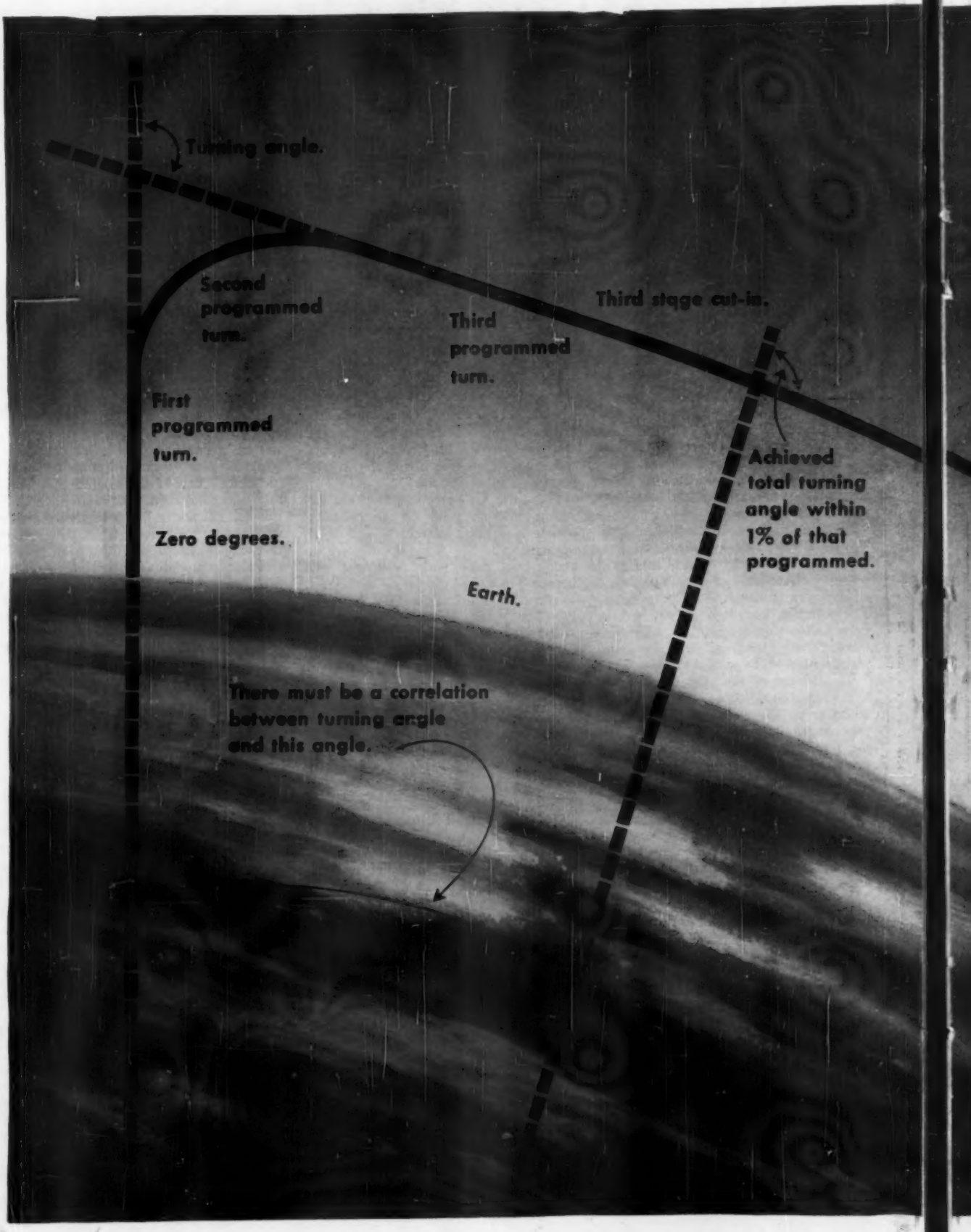
The last significant advance in the specific impulse of solid propellants occurred during World War II. At this time, Allegany Ballistics Laboratory, operated for the Navy by Hercules, started producing double-base propellants with a specific impulse of 235 (delivered) or 245 (calculated theoretical). This was considerably higher than the I_{sp} of the solid propellants that were being imported from England. It is also close to the maximum theoretical specific impulse attainable with the conventional CHON (carbon-hydrogen-oxygen-nitrogen) molecular network that, until now, has been the chemical base for both composite and double-base propellants. And, contrary to some reports, none of the actual delivered specific impulses of today's solid propellants has moved much beyond this World War II mark.

Specific impulses aside, the over-all performance of solid propellants, of course, has advanced significantly in the past decade. Propellant producers have learned how to formulate ballistic properties more effectively. They have greatly improved handling and processing techniques.

Allegany Ballistics Laboratory, for example, developed a plateau type of double-base propellant in which the sensitivity of the burning rate and, hence, the performance to temperatures and pressures was greatly reduced. The manufacturers have increased batch-to-batch reproducibility; developed case bonding; improved thrust level control; and, most important, have learned how to produce large solid grains such as Thiokol's new 10-ton solid propellant engine.

But throughout all this, the energy capacity or specific impulse of the solids has stayed fairly constant. And it is this barrier that all the producers are now eager to crack.

In conventional propellants, the energy derives from the breaking of the valence bonds which hold the different


Turning angle.
Second programmed turn.
Third programmed turn.
Third stage cut-in.
First programmed turn.
Achieved total turning angle within 1% of that programmed.
Zero degrees.
Earth.
There must be a correlation between turning angle and this angle.

HOW HONEYWELL HELPED VANGUARD I ACHIEVE A NEAR-PERFECT ORBIT

PUTTING a satellite into a long-lived orbit is somewhat like threading a needle's eye—with the needle up in the sky. Vanguard not only had to hit this hypothetical needle's eye but go through it at the correct angle.

Utilizing no signals or impulses from the ground, Vanguard accomplished this superb feat. Did it with its own powerful rocket engines controlled for most effective utilization by its own complex assemblage of components and systems. The Martin Company, prime contractor, designed and built the Vanguard rocket for, and under the close supervision of, the Naval Research Laboratory.

Vanguard's vital space reference system was Honeywell's contribution. And it was this precise system that, in conjunction with the autopilot, (1) guided Vanguard in the proper flight path, and (2) pitched Vanguard at various angles necessary to achieve near-perfect orbit—so nearly perfect that experts estimate the satellite will remain in orbit up to 200 years.

The turn was accomplished as the diagram at left shows. The total turning angle was achieved within 1% of the angle planned.

The Inertial-type Guidance System, used in Vanguard, is an adaptation of Honeywell's True Inertial System which enables a missile to know where it is—and where it is going—by remembering where it started from. Such systems provide non-jammable guidance beyond the reach of radio or radar.

Inertial Guidance is another example of Honeywell's continuing contribution to space research. If you have problems in the design of systems or components for missiles and aircraft, call or write Honeywell, Military Products Group, 2753 Fourth Avenue South, Minneapolis 8, Minn.

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atoms in the propellant molecule together. More specifically, the useful energy available for propulsion as a result of chemical combustion is equal to essentially the difference between the bond energies of the reactants (fuel and oxidizer) and the bond energies of the combustion products. In the following equation (a much simplified representation of the combustion of a carbon compound to produce carbon dioxide and energy, for example:

$$-C-C- + 2\,(0-0) \rightarrow 2\,(0=C=0)$$

It takes 137 kcal of energy per molecule to break the carbon-to-carbon bond and two times 117 kcal to break the two oxygen-to-oxygen bonds. This, in effect, means that 371 kcal of energy was to be put into the reaction to get it to burn. However, each molecule of carbon dioxide that is formed liberates 512 kcal of energy. In this case, 1,024 kcal of energy is released, producing a net useful energy balance of 653 kcal. (The actual determination of useful energy is, of course, much more involved.)

The goal for the propellant chemist then, at least as far as this aspect of the problem is concerned, is the development and utilization of fuels and oxidizers which have very weak bond energies but which, upon combustion, will form reaction products with very strong bond energies. So far, this approach has concentrated on the fuels, particularly upon the replacement of the carbon atoms with light metallic elements. The difference between the bond energies binding carbon atoms in the reactants and those binding it in the combustion products is not so great as the bond energy differences attainable, say, with boron, and many chemists consider this limiting energy of the carbon bond the greatest single block to the development of high energy solids.

There is, however, another important factor in determining specific impulse and that is molecular weight of the combustion products. Actually, specific impulse depends on a number of factors, but the combustion chamber temperature (which is wholly derived from the above mentioned bond energy balance) and the molecular weight of the exhaust products are the dominant ones.

The second major goal, then, is the development of propellants which give low molecular weight combustion products.

There are almost as many ways of reaching these two goals as there are producers trying to make high energy solid propellants. And no matter which route they take, said Dr. Lyman G. Bonner, director of development of Hercules Explosives Dept., the manufacturers will eventually arrive at the same place, namely at hybrid solid propellants. It is just that it will undoubtedly take some longer than others to get there, he adds.

For the double-base producers, there are three possible approaches: the addition of a non-integrated fuel; the addition of a separate oxidizer; and the substitution of some other polymer, in total or in part, for the nitrocellulose. At present, the double-base manufacturer, like the composite producer, is concentrating on the addition of non-integrated fuels. Top current candidates are the light metals from the upper left corner of the periodic table; namely, aluminum, beryllium, boron, lithium, magnesium and sodium.

Primary purpose of the metals is to raise the combustion temperature. They can be added either mechanically or chemically. The mechanical approach is simpler. It consists of mixing the metal, usually in powder form, into the propellant batch before casting or extrusion. In the case of the chemical approach, the metal molecules have to be linked onto the fuel chain. The method of addition makes a slight difference in the combustion temperature but none in combustion products.

The composite producers are also very much interested in this approach. But it is in this area of non-integrated fuels that the double-base people claim to have a big advantage due to the physical and chemical properties of their propellants which, they say, are inherently more favorable to the addition of metals.

Made up of nitrocellulose and nitroglycerin, this double-base propellant is essentially an organic plastic. Inorganic, non-plastic materials such as the light metals, provided they are compatible, can be added to the double-base system in fairly large amounts before the overall plasticity of the mixture diminishes to the point where the compound can no longer be cast or used as a propellant grain.

In the composite propellants, on the other hand, inorganic, non-plastic oxidizers such as ammonium perchlorate already make up most of the mixture. The addition of appreciably more non-plastic material, say in the form of lithium, the double-base makers contend, will seriously impair the physical properties of the composites.

Not so, say the composite producers. In fact, the double-base propellant is at a disadvantage, they claim, because it lacks the versatility of the composites in which the complete binder can be comparatively easily changed or modified to obtain more energy. Moreover, Reaction Motor's Edward De Laney points out, there is an optimum amount of metal that can be added to either system to obtain the maximum energy boost, and this optimum amount falls within the toleration limits of the composites.

Other Factors

The problem, however, is not that simple. The total ingredients in a propellant must add up to 100%. This means that if metals are added, something must be subtracted.

If the composite chemist tries to substitute the metallic fuel for part of the oxidizer, which constitutes up to 80% of composite propellants, he will be left with a fuel rich mixture.

If the fuel, which doubles as the binder, in composites is partially replaced by metals, then the mechanical properties of the grain will suffer, making the processing more difficult although not necessarily impossible.

One way to get around this, of course, is to integrate—that is, add chemically—the metal fuel into the binder molecule. This is what the composite chemists are now trying to do. But, as pointed out, this is a more difficult task than simple mechanical mixing.

In addition, chemical linking severely limits the composite producer's choice of metal additive. If a metal is to be incorporated in the fuel-binder network, it should have multivalence (the degree of combining power; carbon has a valence of four) in order to combine with more than one other atom and so extend the binder chain. (This is essential if the binder is to remain plastic and, thus, effective.)

This requirement rules out, at least

Fuel Identity

At a time when conventional solid propellants are beginning to lose or merge their identities in the quest for higher energy, the original grouping of composite and double-base systems can be recalled to help clarify the changes.

By tradition, the name double-base is reserved for propellants or explosive powders containing nitrocellulose and nitroglycerin. The nitrocellulose acts as the matrix and the nitroglycerin serves as a high energy plasticizer. Both substances contain nitro groups attached to oxygen atoms which are attached to carbon atoms. In effect, each is a homogeneous or integrated propellant containing both fuel and oxidizer. They can burn or can decompose explosively.

Composite propellants, on the other hand, consist of chemically and mechanically distinct fuels and oxidizers. The fuel is generally a non-nitro containing organic polymer such as polyurethane or a polysulfide type of rubber which doubles as a binder to hold the finished propellant grain together. A plasticizer is used to make the fuel-binder pliable. The conventional oxidizer is an inorganic compound, commonly ammonium nitrate or ammonium perchlorate.

temporarily, lithium and sodium which have a valence of one. Left are beryllium and magnesium, each with a valence of two, and boron and aluminum, which each have a valence of three. (Silicon, with a valence of four, might be another possibility depending on what it can be hooked up with.) Beryllium has great potential but, for the present, must defer to boron which is more readily available, easier to process and somewhat less toxic. Magnesium is of interest, but the chemists prefer aluminum which gives them an extra valence for only a slight gain in weight. The choice of metallic fuels for composite propellants then boils down to a decision between boron and aluminum (assuming that the metal is to be added chemically). Currently, boron appears to be the heavy favorite because of its comparatively light weight.

At the same time, however, there are many propulsion people who feel that the factor of physical addition is overplayed and that the ensuing impairment of mechanical properties is not serious. Aerojet, among others, is actively exploring the potential of aluminum. And there are fuel chemists who are interested in lithium which is the lightest in weight of all the metals.

There are other routes to high energy solid hybrids. The more important of these go by way of the oxidizer.

One of the most interesting approaches, for example, involves the nitration of the fuel-binder polymer in composites. Under study at Aerojet, this, in effect, makes the oxidizer component an integral part of the fuel molecule, thereby bringing the composition of the composite closer to that of the double-base. This has two effects. It makes the composite more stable. More important, it reduces the amount of oxidizer that must be added in the form of inorganic, nonplastic compounds such as ammonium perchlorate. This could do much to smooth the way for the mechanical addition of the light metals mentioned above. In effect, the inorganic metal fuel would replace that part of the inorganic oxidizer that had been integrated into the organic fuel-binder network, resulting in increased energy with no impairment of the grain's mechanical properties. Reportedly, Aerojet has been successful in its efforts to incorporate oxygen groups in the polyurethane molecule, improving its fuel characteristics without hurting its binder value.

The analogue of this for double-base propellants, the addition of separate inorganic oxidizers such as ammonium nitrate, offers nothing in the way of an energy gain. Double-base propellants already have energetic oxidizer components, and generally the addition of external oxidizers—as is done in dynamite, JATO units, and starter cartridges—actually tends to lower the energy of the double-base system.

But the double-base producers, as well as the composite manufacturers, are very much interested in new, high energy oxidizers that can be made into polymers. Like the liquid propellant people, both solid groups see fluorine as the ultimate, high energy oxidizer. Fluorine far outshines oxygen as an oxidizer with most fuels, except those high in carbon content. It is particularly good with the metals. Thus, as the trend toward the replacement of the carbon in fuels with metals grows, the need for fluorine will follow closely.

Moreover, fluorine polymers are already commercially available. (Teflon and Kel-F are the names of two series of fluorocarbon plastics that have been on the market for a number of years). These demonstrate that fluorine can be produced in polymeric form. Unfortunately, however, existing fluorine polymers are extremely low energy systems—in fact, they are generally advertised on the basis of their inertness. And it may be another five years before someone synthesizes the first high energy fluorine polymer.

A specific impulse of about 245 sec. is the highest that chemists have been able to come up with for any working CHON solid propellant. With the new, high energy, solid hybrids, the highest specific impulse the chemists can hope to achieve is somewhere between 300 and 325 sec., since some intrinsic energy is irrevocably lost in tying the molecules into the solid state.

But this is high enough to satisfy most of the solid propellant producers; it represents a significant gain over present day propellant performance; it is more than enough to meet all currently foreseeable military missile needs.

Most solid propellant producers are sure they can reach this goal. Right now, of course, no one knows exactly how he is going to get there. But that doesn't matter as long as everyone has a good idea of the general direction. And the general direction, most chemists agree, is toward metal fuels and polymeric fluorine oxidizers.

The thing to do, Dr. Bonner says, is to start with the technology and materials now available. For both the composite and double-base propellant producers, this means the addition of light metals to present mixes, a step which many of them already have taken.

The next step will entail a substantial substitution of the metal atoms for the carbon atoms in the fuel molecule. To accomplish this, the composite chemist will probably have to link the metal atoms to the fuel chain chemically or incorporate an oxidizer group in the fuel molecule and thereby substitutes the metal fuel for the displaced oxidizer.

Eventually, in both the double-base and composite propellants, the inorganic, non-plastic metals will completely replace the carbon. At this point, double-base propellants as such will have disappeared, and the composite propellants will be left without a binder to hold the grain together.

One way to preclude this will be to develop a non-carbon fuel polymer incorporating the metal. A better method—i.e., one with a greater energy potential—will be to develop a high energy oxidizer polymer based on fluorine.

Ideally, of course, the near-perfect propellant combination, from the energy aspect, for solids, as for liquids, would be the combination of hydrogen and fluorine. But producing either of these elements in a pure, solid state is a physical impossibility. The next best thing, of course, is to come as close to the ideal as chemically and physically possible, in other words, a fuel combining the maximum amount of hydrogen with the minimum amount of other elements needed to produce a solid state and an oxidizer with the maximum amount of fluorine combined with the least amount of other elements required to form a solid polymer.

In practical or attainable terms, it boils down to light metal hydrides, very likely lithium hydride or boron hydride, and a polymeric oxidizer containing fluorine, oxygen and nitrogen. This then, is what many chemists see as the ultimate solid propellant. It won't look much like any of today's solid combinations; but it will, they are confident, be good enough to develop a specific impulse of 300 sec.

Advanced Nose Cone Developed for Polaris

Sunnyvale, Calif.—Lockheed Missile Systems Division, prime contractor and missile systems manager for Navy's Polaris fleet ballistic missile, has developed an advanced, highly-refined nose cone. Development was made after numerous proving flights with "Polaris, Junior Grade," a six-ton ballistic rocket based on the Air Force's X-17 test vehicle, but modified to provide more advanced data for re-entry body design for Polaris. Goal of the test flights has been to find shapes and materials for a nose cone that will withstand re-entry heat while carrying Polaris' atomic warhead to target. Solid fueled "Polaris, J.G.," compiled a 100% reliability record in Navy tests.

Recent test firings in the Polaris development program have involved new type solid fuel test missiles devised by Lockheed to flight-prove components and systems.

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Mace's Atran Guidance Resists Jamming

By Philip J. Klass

Holloman AFB, N. M.—Air Force's Mace TM-76 missile, much-improved version of the Matador TM-61 surface-to-surface missile, is equipped with novel self-contained guidance that permits surprise low-level attacks and is practically immune to enemy jamming, greatly increasing Tactical Air Command's mobility and all-weather bombing capability. Mace also carries larger nuclear warhead and has greater range than the Matador.

First TAC Mace squadrons will become operational this fall. Mace is in production at Martin-Baltimore.

Self-contained guidance gives the Martin Mace a major tactical advantage over Matador, which requires use of one or more ground radars and radio command guidance, both vulnerable to enemy jamming. Mace is designed to use either of two self-contained guidance systems:

• **TM-76A uses Atran** (Automatic Terrain Recognition and Navigation) system developed by Goodyear Aircraft Corp. Novel system employs airborne radar, compares what it "sees" with actual or simulated radar photos made of terrain prior to flight to determine whether Mace is following course.

• **TM-76B uses inertial guidance** system developed by AC Spark Plug Division of General Motors. Gyro stabilized platform is essentially the same as one used in the Thor intermediate range ballistic missile guidance system (AW Dec. 30, 1957, p. 38), but the computer differs from Thor unit.

Atran will have "considerably better" accuracy than inertial system, according to USAF spokesman. However, it has a disadvantage in that it radiates electromagnetic energy which can be detected by enemy countermeasure reconnaissance receivers.

Initial Mace squadrons will be outfitted with Atran-guided missiles. When inertial system goes into production, both types will be used in undisclosed ratios. Guidance equipment is installed in interchangeable nose sections which makes it possible to convert TM-76A to a 76B, or vice versa.

Use of self-contained guidance in Mace gives it advantages which should provide "tremendous increase" in TAC capability, according to Brig. Gen. William Momyer, new TAC director of plans. They include:

• **Decreased vulnerability.** With self-contained guidance, Mace can operate at extremely low altitudes and below enemy radar coverage, which should make it a difficult target for the enemy. Both types of guidance enable Mace to fly a non-direct route to target at different altitude programs to further enhance element of surprise.

• **More security.** Elimination of ground radar, radio command required for Matador makes it more difficult for enemy to locate Mace launching areas by their electromagnetic radiation.

• **Greater mobility.** Elimination of ground-based guidance also greatly reduces amount of required supporting equipment, eases logistics problems, makes it possible to disperse Mace missiles at smaller sites scattered around a larger area.

• **Relatively jam-proof.** Inertial guidance system is completely invulnerable to enemy jamming. Atran is extremely difficult to jam, compared to Matador. During recent tests, six ground jammers were unable to disturb an Atran-equipped Mace flying at altitudes under 1,000 ft., Air Force says.

Although Mace resembles its predecessor in appearance, it is 50% heavier, four ft. longer, has shorter wingspan and uses turbojet engine with 40% more thrust. Mace highlights, with some corresponding Matador figures shown in parentheses, include:

• **Speed:** Over 650 mph.
• **Maximum altitude:** Over 40,000 ft.
• **Range:** Over 650 mi.
• **Powerplant:** Allison J-33-A-41, rated 5,200 lb. thrust. (Allison J-33-A-37, rated 3,700 lb. thrust.)
• **Booster rocket:** Approximately 100,000 lb. thrust.
• **Gross weight:** Approximately 18,000 lb. (12,000 lb.).
• **Wingspan:** 22.9 ft. (29 ft.). Mace wings are designed to fold for storage.
• **Diameter:** 54 in. (54 in.).

First official details on the Goodyear Atran guidance system were reported during recent Air Force-Martin demonstration of the Mace here at Holloman AFB. The system, whose initial development began more than 10 years ago, operates in much the same way as a human would employ airborne radar for navigation, comparing prominent landmarks on a map—roads, lakes, mountains, etc.—with equivalent landmarks appearing on airborne radar scope.

Instead of using a map, Atran compares the airborne radar picture with one of a series of actual or simulated radar "maps" of the terrain over which the missile is flying. These can be made by actual airborne radar reconnaissance when the terrain is in friendly hands. For inaccessible targets, a simulated radar map is made by constructing miniature models of the area using available topographical maps.

Separate radar photo is made at periodic intervals, say 10 miles, along the desired course to target. Library of such film strips would normally be prepared in advance for a variety of potential targets. Mace is armed for a particular target by inserting an appropriate film strip in its Atran guidance system.

After Mace launch, film strip advances one frame at a time at regular intervals. Atran's airborne radar scope picture is then compared with pre-recorded film strip frame in a photocell mosaic which generates control signals for missile's autopilot. Autopilot, using magnetic amplifiers throughout, is produced by Hallamore Electronics Division of the Siegler Corp.

Atran guidance sytsem is not easily confused by electronic countermeasures. Enemy must obliterate a sizable portion of the area being scanned by Mace's radar and this would require dozens of jamming equipments, suitably placed along missile's intended route, Air Force says.

Present Atran weighs about 600 lb., including radar. System uses vacuum tubes and magnetic amplifiers almost entirely. New version now under development is expected to weigh less.

Availability of two different guidance systems, each with its particular advantages, increases flexibility of TAC's new tactical missile. Atran has pinpoint accuracy, Air Force says, at low altitudes, but cannot be used at very high altitudes or over uncharted areas—unless radar beacons can be "planted" along the projected course. For such situations, TAC will use the inertially-guided TM-76 which only requires prior knowledge of target location relative to launch point.

Goodyear reportedly is developing a new hybrid inertial-Atran guidance system, for possible use on Navy's Regulus II, which will combine the advantages of both techniques.

Mace can be outfitted with parachute pack in place of warhead, which permits recovery of experimental and training missiles. Radio command from chase plane or from the ground causes the engine to be throttled back to 60% power, pops a drag chute and sets controls for descent. When the missile reaches 2,500 ft. and has slowed sufficiently, the drag chute is cut free and three 100-ft. cargo chutes are released. Large rubberized bags pop out of belly at same time, are inflated with compressed air to cushion landing.

Air Force Missile Development Center here has successfully flown three TM-76A Atran-guided missions out of three attempts from Holloman to Wendover AFB, Utah, 650 miles north. Five out of eight other partially off-range missions were 100% successful.

Two radomes under HSS-1N's fuselage are part of installation which permits hands-off hovering and instrument flight.

Anti-Sub HSS-1N Hovers 'Hands Off'

U. S. Navy's HSS-1N helicopter is equipped for operation under instrument flight conditions. Newest Navy version of the Sikorsky S-58, HSS-1N is now in production. Its primary mission will be anti-submarine warfare. Special instruments include Ryan C. W. Doppler radar to measure ground speed and drift, radar altimeter to measure height, automatic engine rpm. controls, and "hover coupler." Coupler uses radar data to automatically bring the aircraft from cruising at 200 ft. altitude and 80 kt. airspeed to a zero groundspeed hover at 50 ft. at a preselected location. Pilot monitors hover on cockpit instrument (AW June 2, p. 24).

HSS-1N is carrying Mk.43 acoustic-homing anti-submarine torpedo (AW Feb. 10, p. 97).

Pilot hovers hands off in an HSS-1N with sonar ball submerged.

Arrow points to hovering indicator used with flight control system.

Rotodyne Design Undergoes Flight Test

White Waltham, England—Fairey Rotodyne VTOL transport, which recently demonstrated transitions from helicopter to autogyro configuration, has made more than 80 flights since it first became airborne Nov. 6, 1957.

Effectiveness of the powered pitch control mechanism was demonstrated by the company's chief test pilot, Sqdn. Ldr. Ronald Gellatly, during hovering tests over the landing pad.

Descent rates well below 3 fps. were achieved.

Banked turns up to 35 deg. currently are being used in the autogyro flight condition.

The prototype Rotodyne VTOL obtains yaw control during autogyro flight configuration by different pitch control of the twin, forward-facing, wing-mounted, 3,000 bhp. Napier Eland engines (AW Dec. 2, p. 54).

Twenty percent of the turboprops output is reserved for this condition and for driving the auxiliaries.

Development Funds

Discussing development prospects of the Rotodyne, Company Chairman G. W. Hall said the company would need to expedite its current program and obtain a certificate of airworthiness within three years in order to keep its current three to five year lead. To meet this target would require two more prototypes and two production aircraft costing $22-30 million.

A newly-formed aircraft manufacturing company—a consortium of de Havilland, Hunting and Fairey—might assist in the program.

But Hall indicated that without a substantial contribution from the government the whole development of the machine, at least, in Great Britain, would be hazarded.

Current opinion maintains little hope that the government will support the project to the extent needed.

Cost of the Rotodyne is put at just over $1 million.

This probably would fall to about $850,000 if sufficient number of orders were placed.

The company is convinced there is large world sales potential for this new type of short haul airliner. Airlines currently interested include Air France, Sabena, New York Airways, Chicago Helicopter Airways, and other airline companies in Japan and Europe. The aircraft was recently demonstrated to the USAF. Visibility of the tip jets at night was one of the features stressed. R. L. Lickley, Fairey's engineering director, maintains that the tests so far show a reliability comparable to fixed wing machines.

As many as five flights a day have been accomplished.

Operating Weight

The aircraft is operating at slightly over its designed gross weight of 33,000 lb., and it has established a vertical rate of climb of 1,300 fpm., a forward climb of 2,400 fpm. and a level flight speed of 155 mph.

Fairey hopes to soon reach the design speed of 185 mph., which will conclude the present transitional investigation phase.

Fixed undercarriage will be replaced by retractable units in time for Farnborough demonstrations this year.

Rotor speed ranges from 150 rpm. in vertical flight to 125 rpm. in autorotation.

At speeds slightly in excess of 150 rpm. there existed a possibility of ground resonance and the existing undercarriage oleos were locked.

Little change of fuselage attitude occurs with transition from one regime to another. As a helicopter the rotor disk points slightly downward. Total pitch change in passing to autorotation is 5 degrees.

Transition from helicopter flight is initiated at a forward speed of about 110 kt. and commences with a simultaneous pitch coarsening of the forward thrust propellers and a progressive reduction of the compressed air supply to the tip jets.

Finally, the fluid clutches which connect the Eland engines with compressors supplying the tip jets are disengaged and the tip jets extinguished; the complete power from the Elands is then available to drive the forward thrust propellers.

Final stages of the test program will include investigating the single engine characteristics and the double engine-out case.

Noise suppression nozzles now nearing completion will reduce the noise output by 90% and lead to considerable attenuation. It is expected that the nozzles will be fitted in time for the Farnborough display. George Flintoff, in charge of engine development testing, said that noise suppression characteristics of the Fairey nozzles are based on approximating the theoretical cross section for zero noise output—an infinitely thin slot which also has zero throughout.

To obtain a practical nozzle of finite area the company has used a multiple assembly of radial vee slots disposed around a conical core.

Design requirements are different and metallurgically more severe than those involved in silencing turbojet engines on fixed wing aircraft. Owing to short period during which the tip jets are in operation, thrust penalty is unimportant but nozzle drag must be kept to a minimum.

Nozzle Drag Problem

Also maximum gas conditions with the tip jet of 2,000C and 65 psi. are much worse than those of the turbojet which has a maximum of 850C and 65 psi. This fact gives rise to additional cooling problems. Fairey uses Nimonic 80 and a direct slip stream between the slots which are double walled and

Breguet 1001 Taon Modified for Speed Trial

Breguet 1001 Taon light interceptor (AW Sept. 30, p. 26) modified with auxiliary fuel tanks recently flew a closed circuit of 621 mi. in 57 min. 23 sec., equivalent to 650 mph. Performance surpassed record set by French Dassault Etendard Jan. 18. French Taon has been modified with two lateral fairings at the wing roots to lower drag at high speeds.

GUIDANCE and TELEMETRY

by Bendix-Pacific

Because of Bendix-Pacific's seasoned engineering background in both missile electronics and telemetry, this Division has been selected as a major subcontractor to develop and supply both an advanced missile guidance system and the complete telemetering system for the Talos Missile Program. Bendix Products Division, Missile Section, is the prime contractor for Talos.

The Bendix-Pacific guidance system, originally conceived by the Applied Physics Laboratory of The Johns Hopkins University, is recognized as a distinct forward step in the state of the art . . . while the telemetering equipment represents the first transistorized system in quantity production.

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cooled internally by air bled from the tip jet compressor. Over-all efficiency of the tip jet is approximately 2 lb./lb. thrust-hr.

Fairey's propulsion expert, A. E. Stephan, told AVIATION WEEK that freeing the airframe from rotor torque reaction meant the only real size limitation would be presented by the task of keeping giant rotor tips off the ground. He considered immediately feasible a scaled up four engine version of the Rotodyne, having 200 seats, a rotor 120 ft. dia., and an all-up weight of 70,000 lb.

Stephan, who joined Fairey in 1947, designed with Doblhoff and first flew a helicopter with tip jets in Germany in 1943, the work being under the direction of Messerschmitt.

Lualdi L.55 Emphasizes Stability, Control With 'One-Hand' System

Milan, Italy—A unique "one-hand" control system, simplified instrumentation and a further development of the Hiller rotor system characterize the L.55 four-place helicopter developed by Aer Lualdi & C., S.P.A. of Rome.

Photo of the L.55 appeared in AVIATION WEEK March 10, p. 81.

Major purpose of the project was to develop a helicopter design which would make some specific contributions to the state of the art. Lualdi's engineering team felt that helicopter stability and control was an area where some improvement was definitely needed, and went to work on those problems.

Hiller Rotor System

First to be tackled was the Hiller rotor system. Lualdi, Hiller representative in Italy, was thoroughly familiar with the system and rated it good. But the engineers felt that the response characteristics of the rotor were a little too abrupt for a novice rotary-wing pilot. They slowed the response rate of the system by increasing its rotary moment of inertia; weights, fastened to the stabilizer rotor surfaces with cables, do the job simply.

Next step was to tie the collective pitch-throttle operation into the cyclic control stick, so that a pilot could fly the plane either using both hands or one. This was done by putting two switches on the cyclic stick where they could be easily reached with the pilot's thumb. One switch increased collective pitch and throttle proportionately, and the other switch reduced both settings.

Third basic problem area—instrumentation—was improved by Lualdi engineers in two ways:

- **Power-margin instrument** was added to the panel. This unit shows with two needles the power available and the power being used in percentage of full-throttle setting. Thus the pilot can see instantly just what power margin he has available in any situation.
- **Check lights and pushbuttons** for temperature indications. A large central dial mounts a series of scales indicating temperature ranges; below the dial is a bank of pushbuttons with indicator lights, labeled for individual cylinder, carburetor air, oil and other temperatures. If one of the lights goes on, the temperature is above limits. By pushing the proper button, the pilot gets the actual temperature reading of any point.

Test Phase

Total flight time on the L.55 at the end of April was 20 hr. in the air and 180 on the ground. Lualdi's chief pilot feels satisfied with the first phase of the tests.

Company plans production of the helicopter at the former Caproni factory in Trento; this area has been taken over for production of the Aeromilano Falco and Nibbio sport planes and will have the capacity to handle the Lualdi helicopter as well.

Planned price of the L.55 in production is $30,000 FAF.

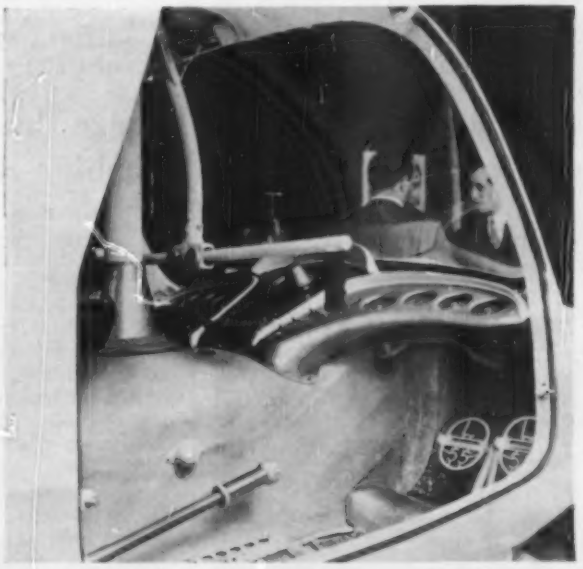
Lualdi L.55

Max. length including rotor	38.8 ft.
Max. height	9.4 ft.
Weight empty	1,320 lb.
Weight of pilot and three passengers	618 lb.
Weight of fuel and oil	198 lb.
Baggage allowance	176 lb.
Gross weight	2,310 lb.

Performance

(With 180 hp. Lycoming engine)

Max. speed	99.5 mph.
Cruise speed at 75% power	80.7 mph.
Rate of climb	985 fpm.
Hovering ceiling with ground effect	9,190 ft.
Endurance	3 hr.



LUALDI L.55 rotor clutch is located at the base of the helicopter's mast (left). Right side is manufactured with removable seat; temperature control system is at center.

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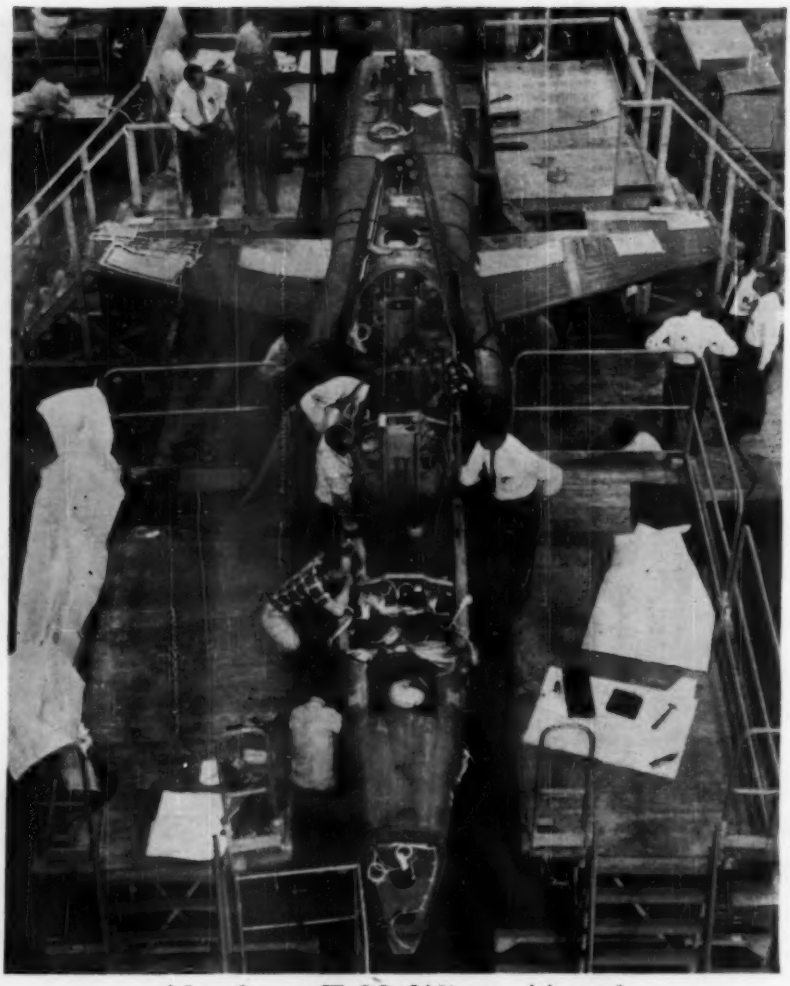

Northrop T-38 Wings Mated

Engineers mate wings of Northrop T-38 supersonic jet trainer at Northrop Division facility, Hawthorne, Calif. Aircraft will be flight tested after other installations are completed. Fighter version is N-156F, now in mockup stage and designed to meet requirements of SEATO and NATO nations (AW April 21, p. 119). T-38 is being built for USAF.

Forge Press Reduces Turbine Rotor Cost

Application of forging press methods in fabrication of turbine rotors for jet and gas turbine engines is said to provide substantial savings in comparison with conventional techniques.

Ford Motor Co., whose engineering research office developed the process, says that savings result from elimination of close tolerance broaching (machining) of blade roots (a fir tree configuration) and blade root cavities. Ford entered the rotor production field via research work on turbine powerplants for automobiles. High cost of turbine rotors induced the investigation of fabrication techniques.

In the forge press method, blades are positioned by means of an outside ring and an inner die. Kirksite, an alloy that melts at 700F, is poured around the blades and allowed to solidify.

Inner die then is removed and hot billet is substituted. Heavy forging press extrudes this billet around the exposed blade roots forming the rotor unit. After removal of Kirksite, wheel hub is machined to finish the rotor. Ford reports that extrusion at high temperatures causes no loss of metal properties.

Forging process is being used in rotor production by Steel Improvement and Forge Co., Cleveland, Ohio, in cooperation with Ford engineering research. Steel Improvement says that it can produce 6 in. and 9 in. axial turbine wheels at less than $100 each plus cost of blades. Ford calculations indicate that 30 in. dia. rotors can be fabricated with a press of 30,000 tons capacity.

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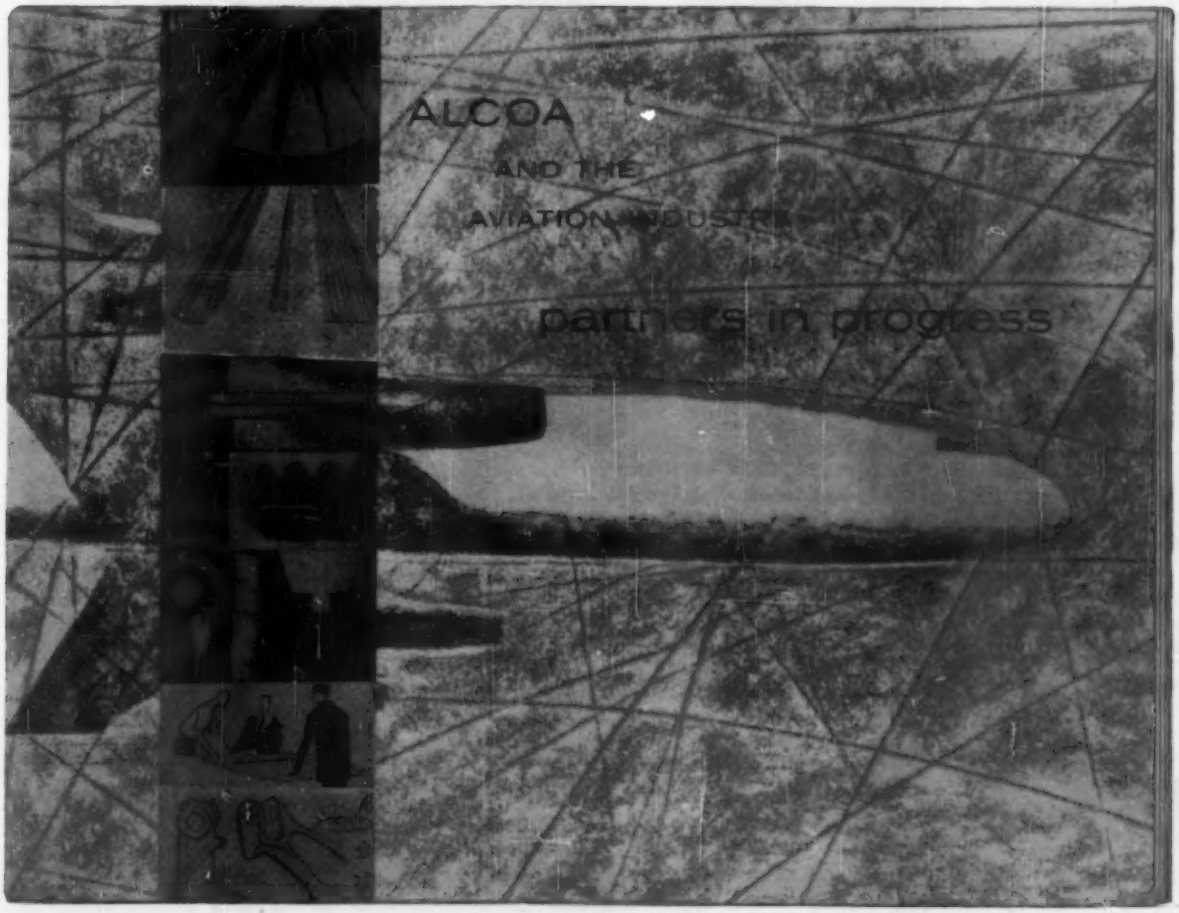


Foam Plastic Models Replace Balsa Types

Dallas—The Chance Vought Aircraft model builders are using plastic foam resins to do a faster, cheaper job of turning out small wind tunnel models in quantity.

Foam plastic method replaces the older practices of making models of hand-carved balsa wood or constructing them of Fiberglas with balsa bulkheads. The new plastic models are stronger than the balsa versions and weigh half as much. They are more economical because they can be turned out faster.

The foam plastic technique was used to produce two specific models for wind tunnel testing. One was a droppable fuel tank and the other an ejection capsule design for high speed aircraft. Several versions of each were built to test various configurations.

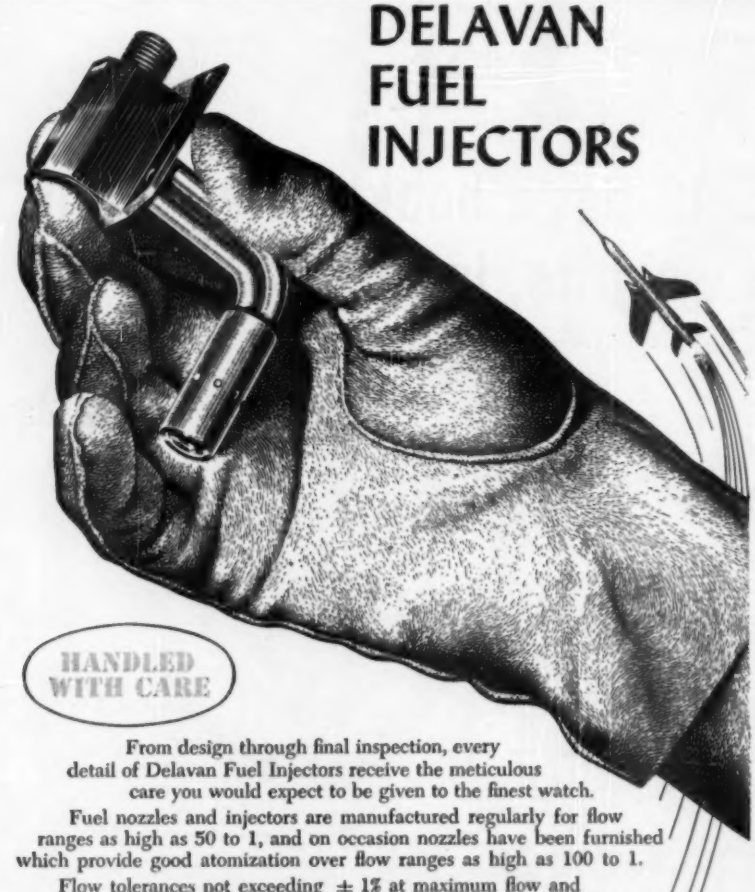
In the new process, Fiberglas cloth is laid in a mold which has been waxed to prevent bonding. Then liquid resin and catalyst is poured into the molds. Chemical reaction expands the liquid until it fills the mold; when it sets, it produces a hard, smooth surface.

Use of a light, strong material is important for the test models because they are released in the wind tunnel airflow to study tumbling characteristics at high speeds.

Chance Vought model builders are studying the feasibility of building display models with the foam plastic process. Display models are now made of heavier epoxy resin cast in molds or of hand carved mahogany.

FOAM PLASTIC material is poured into mold where it expands and fills the mold, sets into a lighter, more rigid model than those built by older processes.

DELAVAN FUEL INJECTORS



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Fuel nozzles and injectors are manufactured regularly for flow ranges as high as 50 to 1, and on occasion nozzles have been furnished which provide good atomization over flow ranges as high as 100 to 1.

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Delavan designs and produces Fuel Injection devices for America's leading aircraft and missile engine manufacturers.

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PRODUCTION BRIEFING

Aeronutronic Systems, Inc., Los Angeles, Calif., will study guided missile and range instrumentation under $482,050 Army contract. Study, requiring 15 months, will be undertaken in the Glendale and Newport Beach facilities of the company.

Georgia Pipe Line Co., Savannah, Ga., will transport jet fuel from Savannah Port to Hunter AFB, by means of nine mile pipeline, now under construction. Construction cost of the six-inch pipeline will exceed $300,000.

Corning Glass Works, Corning, N. Y., will develop high temperature windshields for aircraft under $2,380,000 Air Force contract. Three-year development contract calls for flat and curved windshields that will withstand continuous use at temperatures of 850 to 900F.

Wyle Associates, El Segundo, Calif., is operating a new cryogenics test facility at Norco, Calif. Plant is designed to test ICBM and other weapon system components with actual media at actual flow rates. Utilizing a 20 million Btu/hr. heat exchanger, the system can produce liquid oxygen flows at 8,000 gpm. and gaseous oxygen flows up to 40 lb. per sec.

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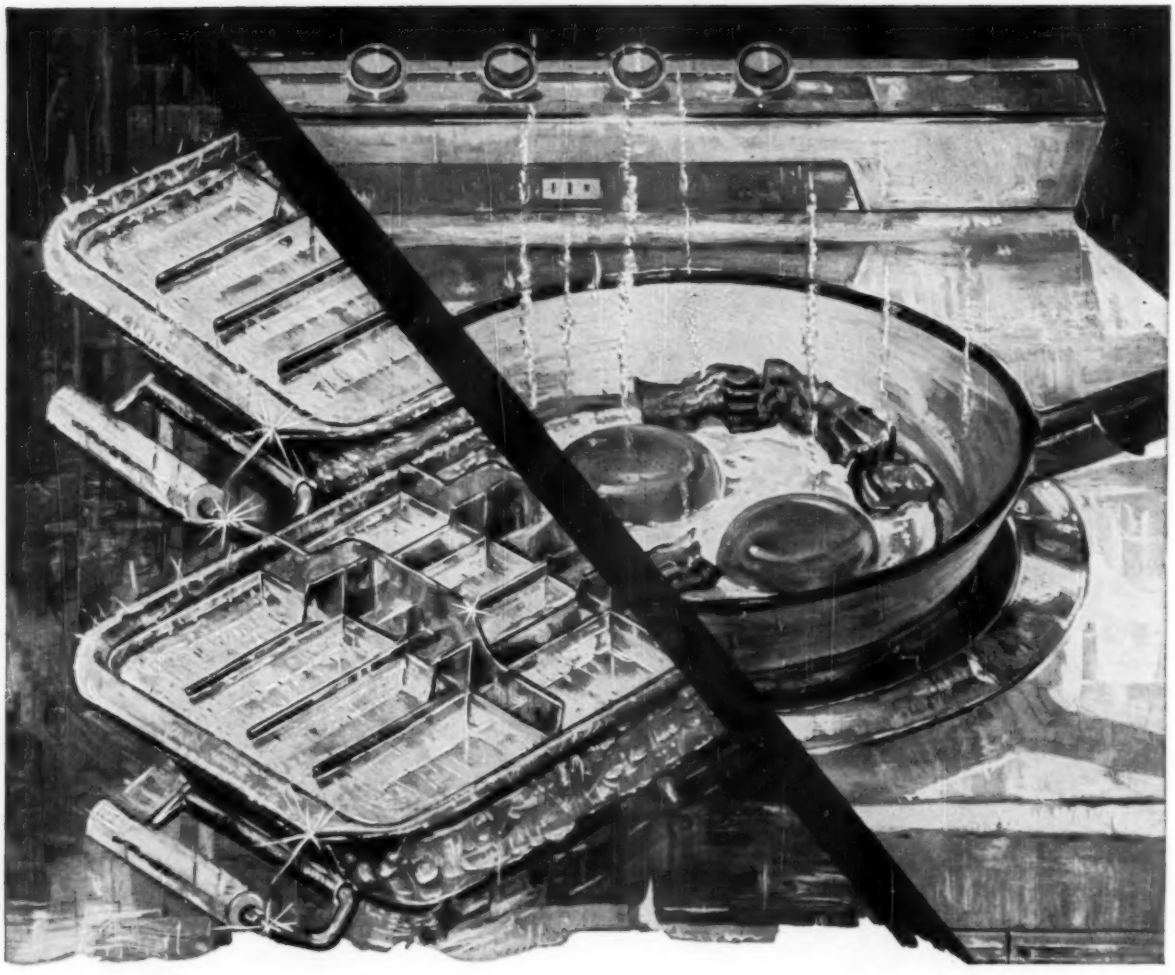

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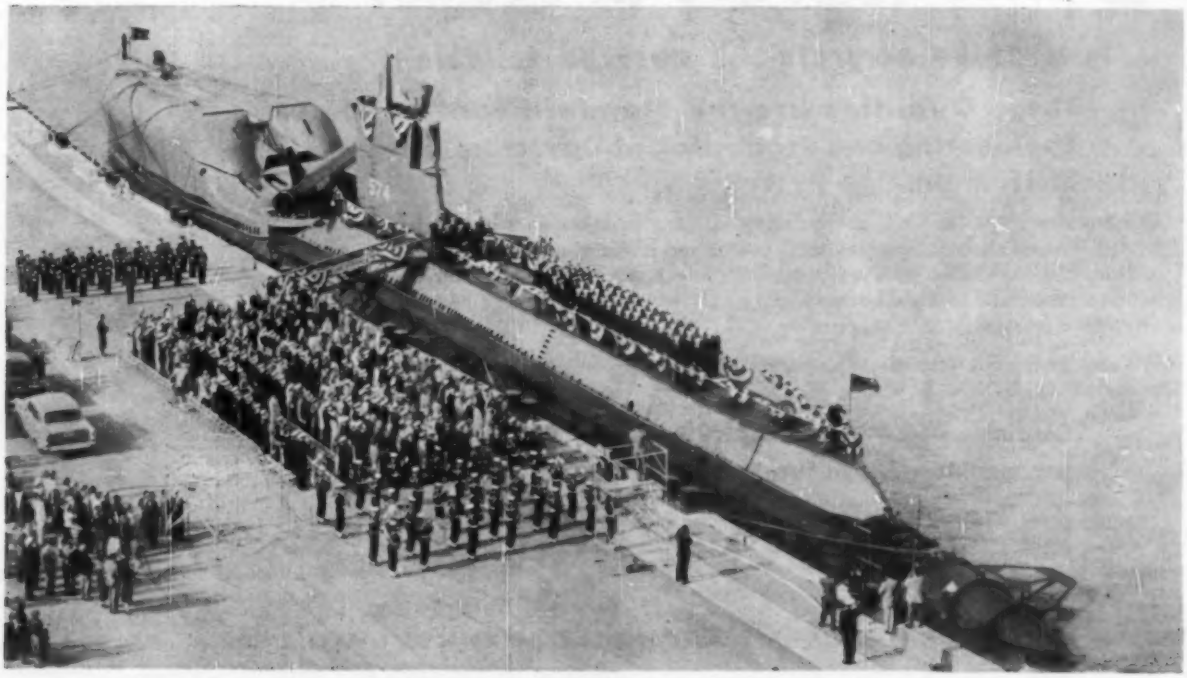
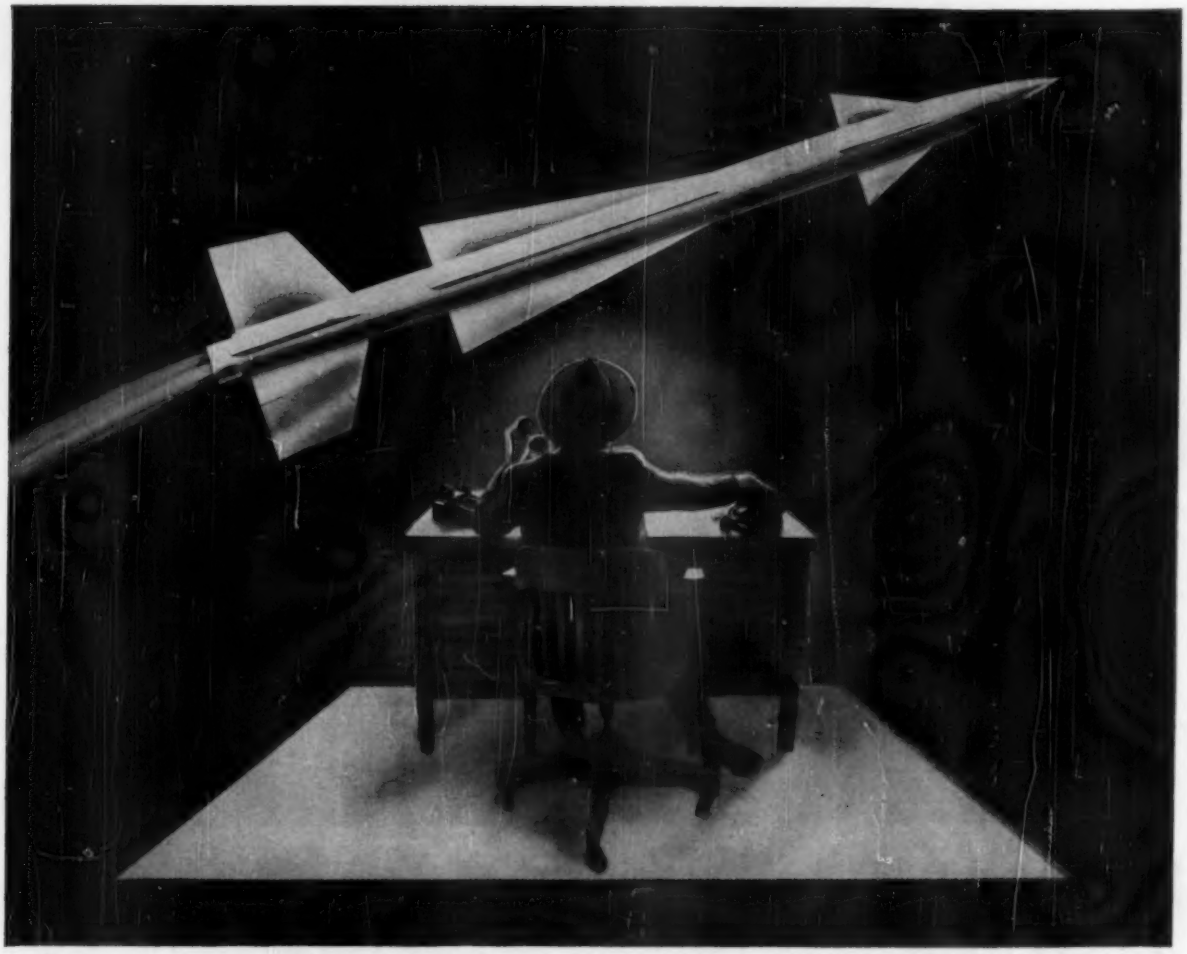
Regulus II Tested For Fleet Duty

One of two Chance Vought F8U chase planes (far left) and a Lockheed TV-2 (left) follow a Chance Vought Regulus II launched at Pt. Mugu, Calif. Recovery at Antelope Dry Lake, Nev., was commanded from the TV-2 after the inertially guided missile flew out over the Pacific, returned to the mainland and followed a preset course avoiding populated areas. Navy submarine Grayback (below) which was recently commissioned at Mare Island Naval Shipyard, Vallejo, Calif., carries Regulus II. For firing, missile is pulled out of deck hangar, swiveled to the side on its launcher and fired.





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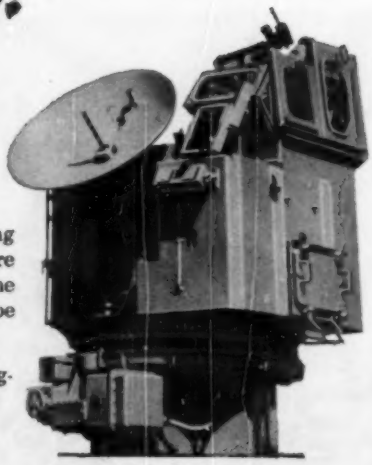

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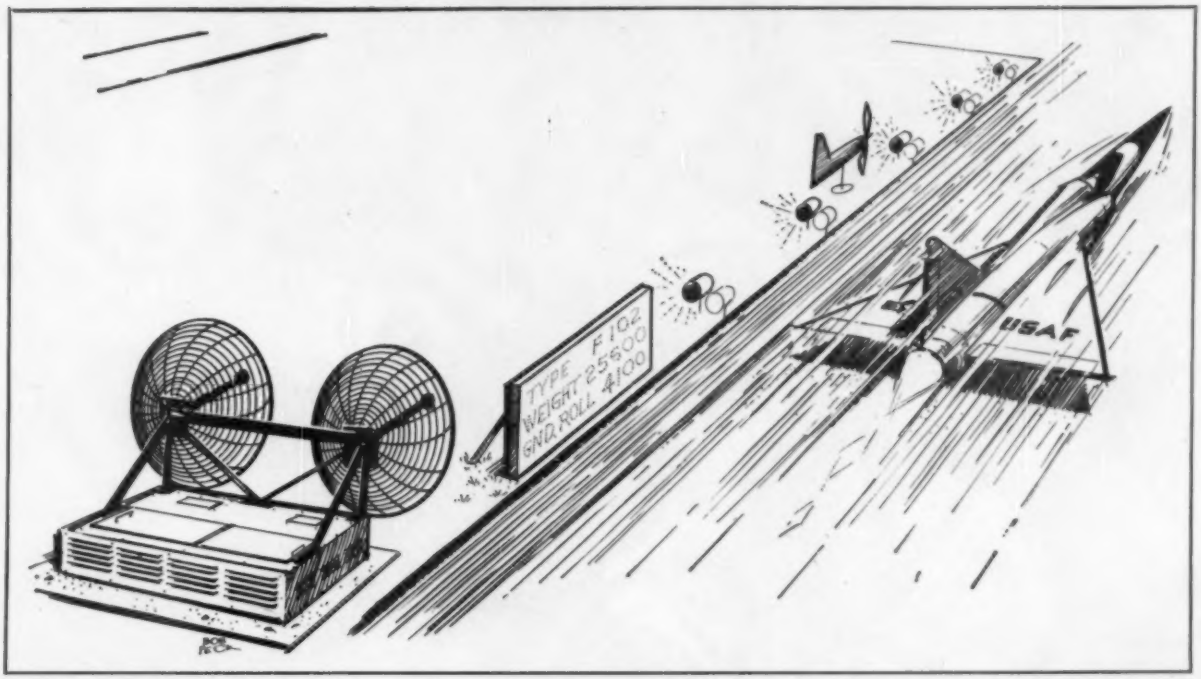

TAKEOFF monitor, ground-based system proposed by Northrop's Nortronics Division, uses radar to measure aircraft speed and acceleration, computes whether airplane can make safe takeoff in available runway. Lights along edge of runway show pilot the status of his takeoff. Kollsman Instrument, Minneapolis-Honeywell and Sperry Gyroscope have designed lightweight monitors for aircraft installation.

Monitor Designed to Aid Jet Takeoffs

By Philip J. Klass

Washington—Takeoff monitor, a new type avionic device which automatically warns a pilot when his aircraft is failing to "make good" during takeoff run, begins flight tests this month.

Device, which promises to reduce hazards and uncertainties of jet takeoffs, was recommended for use in jetliners by recent International Air Transport Assn. technical conference in Miami.

Four manufacturers are developing the new takeoff monitors, sometimes called TOM for short. Kollsman Instrument, Minneapolis-Honeywell and Sperry Gyroscope Co. have designed lightweight monitors which are installed in the aircraft. Northrop Aircraft's Nortronics Division is proposing a ground-based system which requires no equipment in the aircraft itself.

Although all four systems have the common objective of improving safety of takeoff operation, they differ somewhat in the criteria used to determine a potentially unsuccessful takeoff:

• **Kollsman continuously compares** airplane's indicated airspeed, and its rate of change, with "normal" values which should be obtained for particular takeoff conditions: i. e., airplane weight, runway length, temperature, runway altitude and winds. Pilot's airspeed indicator has small marker ("bug") which moves around periphery of dial alongside airspeed pointer to indicate build-up of airspeed required for successful takeoff. System also can provide automatic alarm whenever actual indicated airspeed falls too far behind desired value during takeoff run.

• **Minneapolis-Honeywell compares** airplane's acceleration during takeoff run, as measured by an accelerometer, with acceleration that airplane is expected to achieve for its particular configuration, runway and atmospheric conditions. Monitor sounds alarm whenever airplane acceleration falls significantly below normal for more than a brief instant. System, as proposed, also provides pilot with visual indication of remaining distance to point of refusal—beyond which airplane cannot stop without running out of concrete.

• **Sperry also uses** accelerometer to measure airplane acceleration during takeoff, combined with measurement of dynamic pressure ("q"), to determine whether aircraft is accelerating normally. Sperry provides both an automatic alarm and a visual cockpit indication of actual vs. desired airplane acceleration.

• **Nortronics proposes** to use ground-based Doppler radar and computer, located at end of runway, to measure airplane speed from which it can determine also its acceleration and position along the runway during the takeoff run. From this data, plus information on airplane type, configuration and weight set into computer by control tower, plus local meteorological data, system can predict whether airplane can get off in remaining runway. Takeoff status would be indicated to pilot by means of colored lights installed along edge of runway or by means of his radio.

Accidents Increasing

The advent of jet aircraft has resulted in a marked increase in takeoff accidents.

The reasons include:

• **Jet engine thrust** is more dependent on ambient temperature and pressure-altitude than a piston-engine.

• **Increased takeoff speed** required for jet aircraft has not been accompanied by a proportional increase in length of runways, with the result that the margin between takeoff/stop distance and available runway has steadily decreased.

• **Loss of pilot "cues,"** both kinesthetic

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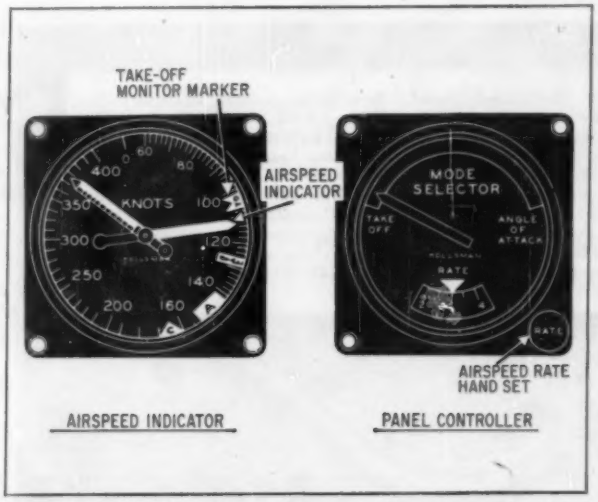
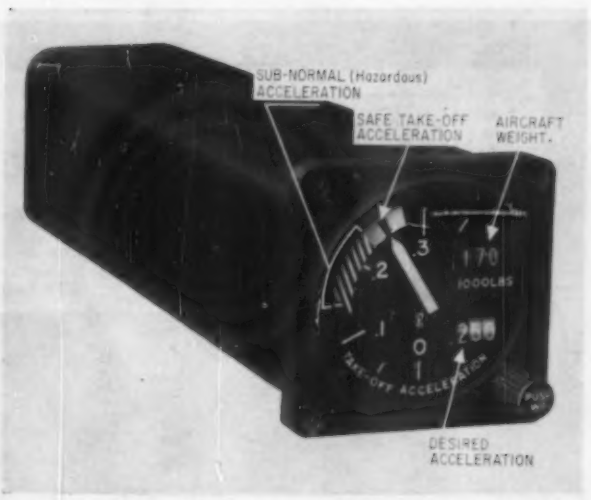




KOLLSMAN takeoff monitor (left) uses small moving marker around perimeter of airspeed indicator to show whether airplane speed is building up at required rate. Panel controller is used to set in desired rate after it is determined from slide rule. Sperry monitor (right) compares actual airplane acceleration with expected values which is pre-calculated for particular takeoff conditions. Separate indicator (at top of Sperry monitor) shows pilot whether airplane acceleration is sub-normal (cross-hatched area).

and auditory, result from jet aircraft's slower acceleration, lack of noise and vibration. This makes it more difficult for pilot to judge whether takeoff run is proceeding normally.

To reduce jet takeoff accidents, the military services now use a "line-check" system in which markers are placed at 1,000-ft. intervals along the runway. For a particular airplane configuration and airport conditions, the pilot precomputes what airspeed he should have reached as he passes each marker, then visually makes a comparison.

Illustrating the brief time interval in which the pilot must make a critical decision on whether to proceed or abort, consider a Century series fighter taking off under no-wind conditions from an 8,000 ft. runway at sea level. Airplane normally should be airborne after a 3,400 ft. roll.

As the airplane passes the 2,000 ft. line-check marker, the pilot has less than two seconds in which to decide whether to continue or abort, if he is to be able to stop in the available runway, according to R. P. Snodgrass, Sperry's director of flight research. Snodgrass cited this example at last year's flight safety symposium in Santa Barbara, Calif.

At best, the present technique is only a spot check. It does not give the pilot advance warning of sub-normal airplane acceleration until he has reached the line-check marker. And for a one-man fighter, the problem of cross-checking passage of marker and airspeed indicator can introduce time lags at an instant when time is critically short.

A needless abort, which sometimes results from use of the line-check system, is costly for both military and airline jet operators. If an airplane is aborted near its refusal speed, brakes, brake drums and tires probably will need to be replaced before the airplane can be flown again. Thus for airlines, price of a needless abort could run into many thousands of dollars in loss of flight time.

New takeoff monitors can give a pilot a continuous appraisal of his airplane's performance from the start of the roll, providing a great deal more time to evaluate the situation and reach a decision on whether or not to abort.

Airborne vs. Ground-based

Although there is sure to be hot competition between companies developing different airborne takeoff monitors, a more basic competition involves the question of whether the monitor should be installed in the airplane or on the ground.

To hold down size, weight and cost of airborne takeoff monitors, and to assure maximum reliability, manufacturers have designed them with more limited capability than the proposed ground-based system.

Although more sophisticated airborne monitors could easily be designed, present units compare actual airplane performance during takeoff run with a norm for the existing airplane configuration, runway and atmospheric conditions. If actual performance falls 10-20% behind this norm (actual figure will come out of flight tests), the airborne device signals for an abort or indicates an abort condition.

Ground-based system proposed by Nortronics is not limited by size or weight considerations, hence can automatically include all possible factors in its determination of whether the airplane can make a successful takeoff under the conditions that exist at the moment, including even such factors as obstructions beyond end of the runway.

To illustrate the fundamental difference between the Nortronics system and most of the airborne monitors designed to date, consider a jet pilot who inadvertently tries to take off on a runway that is far too short for his airplane's gross weight and ambient temperature conditions.

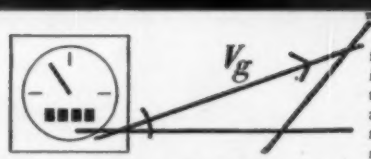
The present airborne takeoff monitors would give the pilot an "all's well" indication so long as his airplane accelerated down the runway at its normal rate, despite the fact that the pilot will run out of concrete before he is airborne. The ground-based system, however, would give the pilot an abort alarm before, or immediately after, he starts his takeoff roll.

The foregoing is an unlikely, but not impossible, situation which serves to point up basic differences between the airborne and ground-based monitor approach.

Here are additional differences:

- **Weight:** Airborne system weighs only 3 to 7 lb. (not installed), including additional cockpit indicator required for Sperry and Honeywell systems. Ground-based system requires no added equipment in airplane.
- **Cost:** Airborne monitors are expected to sell for less than $2,500, plus installation, per airplane. Ground-based system, in production, would probably cost around $75,000 per runway slightly more if dual equipment is included for added reliability.
- **Reliability:** Simplicity of airborne system should make it quite reliable.

Use of dual (standby) equipment

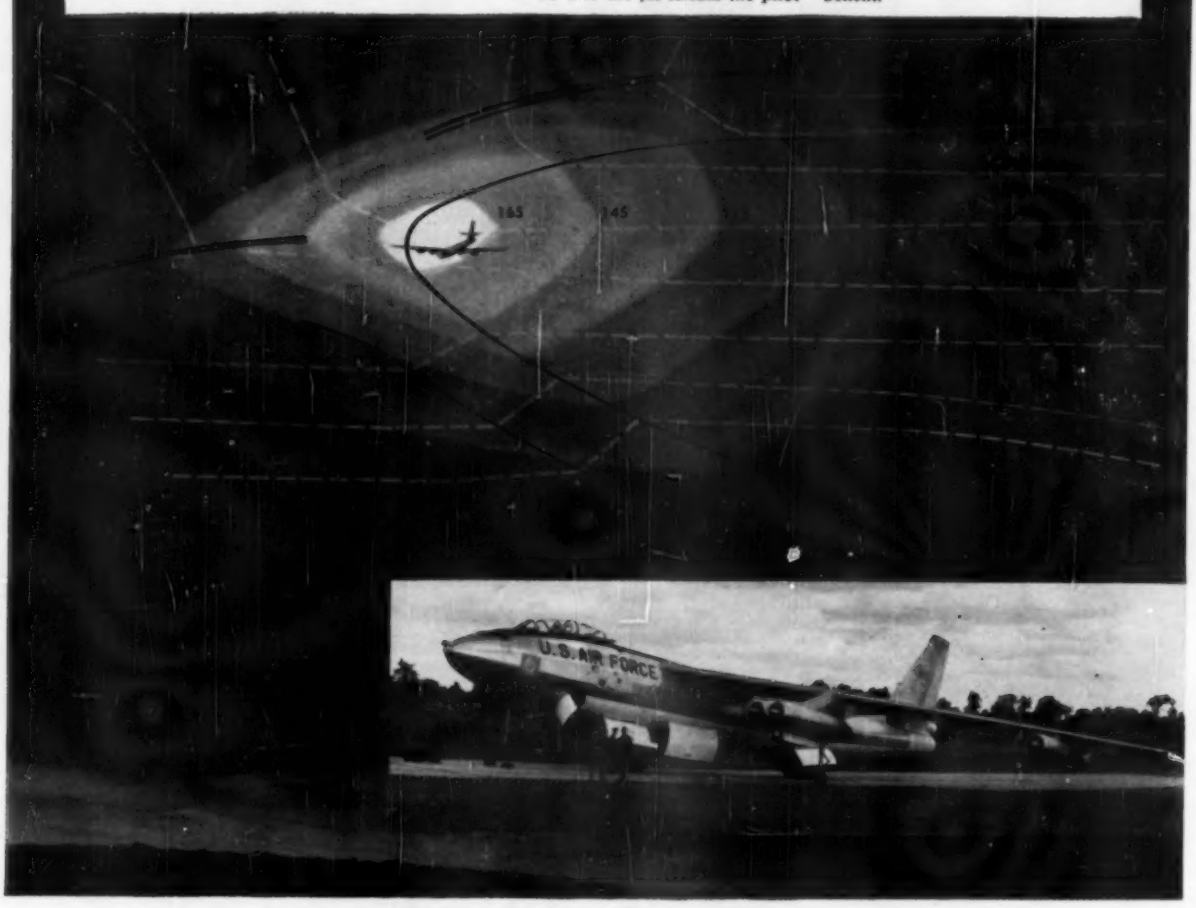


Ground Speed & Drift Angle
Any Time, Anywhere, Any Weather

Jet streams were cross-sectioned for the first time using the capabilities of GPL auto-navigators. Now these same ground speed and drift angle measuring equipments make riding aerial "express-ways" easy for military and civilian fliers.

A leading news magazine's story on the record-setting B-47 flight defined jet stream flying this way:

"To find the jet stream the pilot flies in its general direction . . . When the '66' tells him that his drift angle is increasing, he knows that he is getting into the jet stream . . . When the drift angle reaches a maximum, he turns downstream until the drift angle falls to zero... When the '66' is hooked to the autopilot, the airplane will follow the stream automatically, getting maximum benefit."



Cross-section of a headline

Headlines were made the day a GPL auto-navigator guided a USAF B-47 into the jet stream over California, set her down only 3 hours and 47 minutes later in sight of the Atlantic!

This dramatic use of GPL Doppler Navigation Systems is just one application of their basic function – precise point-to-point navigation – any time, anywhere, any weather. The systems work without ground aid or celestial fixes, have proved themselves over many millions of operational miles. They offer military and civilian pilots continuous, accurate navigation information, including velocity.

RADAN* Navigation Systems, recently released for civilian use, are now available to everyone. They save precious time and fuel for the air lines, provide a priceless margin of safety for all.

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ENGINEERS – GPL achievements have opened up some unusual research and development opportunities. Send resumé to Personnel Manager.

should give a ground-based system roughly equivalent reliability, despite its increased complexity. However, check-out of complete system performance may be slightly easier for a ground-based system.

• **Implementation:** Airplane equipped with an airborne takeoff monitor is assured of protection immediately, on every runway it uses. Airport equipped with ground-based monitor provides such protection to every aircraft operating from its runways without expense to individual aircraft operators.

At the moment, airborne monitors appear to be much closer to availability than the Nortronics ground-based unit. Kollsman is testing its monitor on a Boeing 707. Honeywell is testing a prototype on its own Douglas DC-3, and Sperry has started tests in a Lockheed T-33. (Sperry's monitor was developed under Air Force sponsorship.) Nortronics says it plans to use existing, and proven, highway (speed-trap) radar and that computer has been designed, but not constructed.

Inasmuch as a number of jetliners will go into service during next 12 months, the more immediate availability of the airborne devices could give them a significant competitive edge.

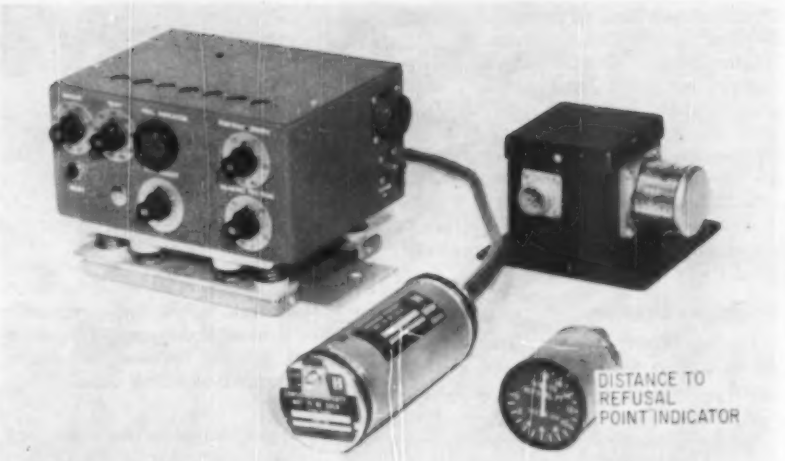
To use the Kollsman takeoff monitor, the pilot will employ a special circular slide rule to compute the value of the airspeed rate which he must set into a small panel controller. First, the pilot will determine required IAS for airplane gross weight and configuration, then add or subtract indicated wind component along runway, to obtain "indicated ground speed." Using this figure, ambient temperature, barometric pressure and allowable runway length, slide rule will give pilot a reading of airspeed rate which he sets into the panel controller.

At the expense of increased complexity and weight, this computation could be performed automatically by the monitor, providing the pilot set in corresponding data on suitable dials (as is done in the Honeywell monitor.)

Airspeed rate value set in by the pilot determines the speed at which a small synchro will be driven by a constant-speed d.c. motor in the panel controller. This in turn will determine the speed at which the marker moves around the periphery of the pilot's IAS indicator.

With the predetermined rate set in, only further action required of the pilot is to push a button at the start of his takeoff roll, which starts motor driving the marker around the airspeed indicator dial. This pilot action could be eliminated by tying in the start of the timing motor with release of the aircraft brakes or advance of engine throttles.

For new Boeing, Convair and Douglas jetliners, which will be equipped with Kollsman's Integrated Flight Instrument System (KIFIS), the takeoff monitor provision can be had for only a few added ounces and dollars. Airspeed indicator already has built into it a small motor and synchro used to drive an angle of attack marker. During takeoff, the motor is merely switched to drive the takeoff monitor marker. For aircraft not equipped with KIFIS, new airspeed indictor and control panel are required, for total weight of perhaps 3 lb., cost of less than $2,500.



HONEYWELL takeoff monitor compares actual airplane acceleration with expected value, sounds alarm when sub-normal. Experimental model above also provides pilot with cockpit indication of distance remaining to point of refusal.

Honeywell Monitor

Present Honeywell monitor is really two systems in combination. One sounds an alarm whenever airplane acceleration falls significantly below normal value. The other gives the pilot a visual indication of distance remaining to point of refusal.

Prior to takeoff, the pilot will be required to set in such data as airplane weight, ambient temperature, pressure, runway length, runway gradient and condition (wet or dry), and whether afterburner will be used.

Just before releasing brakes, the pilot must also adjust a knob to center an instrument needle (to cancel out any spurious acceleration signal from tilt of aircraft pitch axis), then push a button which effectively connects an odometer that measures distance remaining to point of refusal. Latter function could be performed automatically by tying in with brake-release mechanism. Nulling out of spurious acceleration signal might also be performed automatically, at expense of increased complexity, weight and cost.

As now designed, Honeywell monitor does not give the pilot any continuous cockpit indication which shows whether takeoff roll acceleration is normal, but flashes an audible signal or warning light to show sub-normal acceleration. Honeywell does provide a small cockpit indicator which shows, in hundreds of feet, the distance remaining to the point of refusal.

Honeywell's prototype model, now undergoing flight evaluation, weighs 7 lb. (not installed), but the company says the production design will weigh only 5 lb., including the panel indicator and distance-remaining feature. Price is expected to be in the $2,500 to $5,000 range.

Company spokesman concedes that installation of an odometer in the airplane main gear wheel may pose problems unless provision is made during initial aircraft design.

In design of the Sperry takeoff monitor, company has employed principles used by National Advisory Committee for Aeronautics in a similar device which the agency developed several years ago. To hold down complexity, Sperry requires the pilot to set only airplane gross weight and normal (expected) acceleration into its cockpit indicator.

To determine normal acceleration value, the pilot will employ a small slide rule or nomograph which takes into account such factors as airplane configuration, ambient temperature, pressure, runway gradient and whether afterburner will be used.

Pilots currently use similar charts to determine required takeoff distance and speed.

Sperry monitor requires no action by the pilot at the instant that a takeoff run is started. For some types of aircraft, however, compensation may be required because of slight variations in airplane pitch attitude, resulting from different center of gravity locations. This will cause the acceleration sensor to be slightly off from its original

horizontal position, allowing it to sense spurious (gravity) acceleration.

Calculations show that a 1-deg. change in pitch attitude for large jetliners could introduce nearly a 10% error in sensing an airplane's linear acceleration, a figure which is roughly the borderline between acceptable and sub-normal performance. For this reason it may be necessary to introduce pitch axis correction signals from the airplane's vertical gyro.

Visual Indication

During takeoff run, the Sperry cockpit indicator pointer gives the pilot a visual indication of whether airplane's acceleration is normal, high or low. Cross-hatched area on indicator face will show dangerously low acceleration. Automatic audible or warning-light alarm can be provided, if desired.

Sperry's monitor uses no servo systems, operates entirely from d.c.—except when the vertical gyro is needed to compensate for changes in pitch attitude.

Jet aircraft acceleration, under constant thrust condition, decreases slightly as the airplane picks up speed during takeoff roll because of increase in drag. To compensate for this normal fall-off in acceleration, Sperry combines accelerometer signal with one from a dynamic ("q") pressure sensor. Sum of two signals remains constant throughout for normal takeoff run and is independent of ground wind conditions, eliminating wind considerations. (Honeywell introduces similar compensation by means of its odometer signal.)

CONTROL tower console for Nortronics ground-based system enables operator to enter airplane type, weight and configuration into takeoff monitor computer. Console repeats back data for operator confirmation, also shows computed takeoff distance.

Sperry monitor weighs 6¼ lb., including automatic alarm provision and cockpit indicator. Company gives no estimate on price, but it probably will be in the $2,500 range.

The ground-based takeoff monitor which Northrop's Nortronics Division has proposed to Airways Modernization Board, Civil Aeronautics Administration and a number of Air Force Commands, requires the pilot to radio to tower three pieces of information: aircraft type, gross weight and thrust configuration, i.e. whether afterburner will be used, water or alcohol injection, or rocket assist.

Control tower operator then enters this information in takeoff monitor computer by means of small console. (See photo at left). To eliminate possibility of error in pilot to tower transmission, or in tower operator's entry, Nortronics proposes to install a small billboard type display at the end of the runway which will repeat back to the pilot airplane weight, type and computer's calculated distance to point of takeoff. Tower operator's console also has a repeat-back display to assure operator that correct data has been inserted in computer.

Runway Lights

Nortronics proposes to use a series of lights installed along the edge of the runway to give pilot a visual "how-goes-it" indication:

- **Steady green light** will show pilot that airplane is accelerating at rate which will assure safe lift-off within runway limits.
- **Flashing green light** will indicate that airplane has achieved safe takeoff speed.
- **Steady red light** will indicate subnormal acceleration.
- **Flashing red light** will indicate that

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there is no possibility of safe takeoff and that pilot should abort.

• **Lights off** means system inoperative.

Meteorological data on wind velocity, direction, ambient temperature and pressure will be measured at or near the airstrip and be automatically fed into the takeoff monitor computer, according to Max Stanley, Northrop's chief of flight operations. Other factors such as runway length, gradient and possible obstacles beyond edge of runway will be set into the computer.

None of the takeoff monitor manufacturers even suggests that its device be used to automatically apply brakes in event of sub-normal takeoff run. Pilot discretion remains link between new takeoff monitors and decision to abort or proceed with the takeoff.

FILTER CENTER

(Ed. Note: Following are main points of new developments reported at recent National Conference on Aeronautical Electronics in Dayton.)

► **New Transistor Material**—Gallium arsenide, new semiconductor material, shows promise of providing transistors which can operate at temperatures of 300C, slightly above temperature limit of silicon units, with better high frequency characteristics normally found in lower temperature germanium transistors, Neil Di Giacomo, Wright Air Development Center, told recent Dayton avionics conference.

► **Phase Modulation for Digital Transmission**—Widespread use of phase modulation for binary data transmission is predicted by Ferril A. Losee, Hughes Aircraft, as a result of new technique which overcomes previous distortion, multipath and frequency errors associated with phase modulation. Phase modulation offers considerably better performance than AM, requires less bandwidth than FM. New Hughes technique compares phase of each pulse with phase of its predecessor, using magnetostrictive delay line with delay time equal to pulse repetition rate. Side-by-side comparison of new technique with conventional FM, between Los Angeles and Dayton, using same power, frequency and information rate showed phase modulation performance was superior to FM, Losee told recent Dayton avionics conference.

► **Electronic Gyroscopes**—Possibility of using spinning electrons as a gyroscope reference was suggested by T. P. Haney, Westinghouse Electric Corp., at Dayton conference. Precession of spinning electronics, similar to precession of gyro,

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can be produced by strong magnetic field. Same principle is employed for other uses in new Maser atomic amplifiers (AW Aug. 19, p. 76).

► **Air-Ground Meteor Burst Communications**—Preliminary tests in a PBY indicate that meteor burst communications technique (AW June 17, 1957, p. 96), recently developed for point-to-point use can be employed for ground-to-air digital communications, but information rate is relatively low. Tests conducted by Stanford Research Institute used three-element Yagi antenna and a vertical quarter-wave stub mounted on booms in nose and tail of PBY. Teletype signals transmitted from Bozeman, Montana, using 2 kw. transmitter, at 40 mc., were received by airplane flying over northern California, 800 mi. away. Results were reported at Dayton conference in paper authorized by Irving Roth, W. R. Vincent and A. M. Peterson, all of SRI.

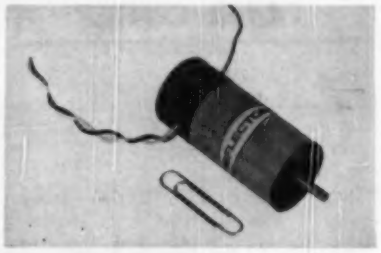
► **Precision Tracker**—New AN/FPS-16 monopulse radar, developed by Radio Corp. of America, is able to establish position of target with strong signal returns with error of no more than 5 sec. of arc (0.02 mil) for extended periods of time, David K. Barton reported at Dayton avionics conference. RCA is producing FPS-16 under Navy contract for use by all three services.

► **New Type Radar Navigator**—Novel type of airborne radar for measuring aircraft/missile ground speed, which does not use Doppler shift principle, has been test flown by General Electric. System employs single transmitter antenna, two receiving antennas along fore-aft axis, two more at right angles. Antennas are aimed vertically downward instead of at an angle as in Doppler systems. Similar echoes from ground are obtained at each of two fore-aft, or spanwise antennas, separated by interval of time which is proportional to vehicle's ground speed. Cross-correlation technique is used to make time measurement, hence system is called "Correlation Navigator." New technique can provide improved accuracy or smaller size than conventional Doppler system, Frank R. Dickey, Jr., told recent Dayton avionics conference. Overwater bias error encountered in Doppler systems is eliminated in new system, Dickey says.

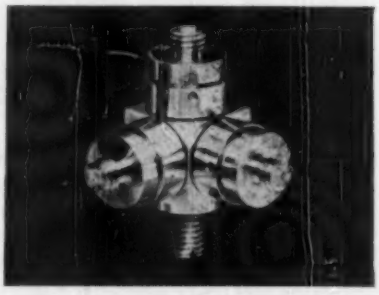
NEW AVIONIC PRODUCTS

Components & Devices

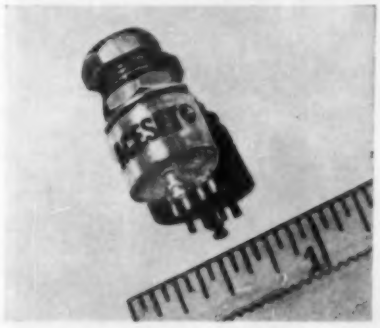
• **DC permanent magnet motors,** offering efficiencies as high as 45%, are available in models from 4 to 30 vdc. Units are of integral construction to reduce length and bulk and utilize new developments in ceramic magnetics. Motors are available with sleeve or ball bearings and with a variety of mounting arrangements. Reflectone Corp., Stamford, Conn.



• **Tri-axial accelerometers,** standard Series 400-TX and miniature Series 500-TX, are designed to simultaneously measure shock and vibration in three mutually perpendicular directions. Units employ piezoelectric ceramics in compression for the sensing element to obtain sensitivities up to 27 mv./G to provide an acceleration response from 0.03 to 40,000G. Natural frequencies range from 20 to 35 kc. for frequency coverage from 1 cps. to 12 kc. Units available with upper temperature limits of 200F or 540F, and range in weight from 13 to 60 grams. Columbia Research Laboratories, MacDade Blvd. and Bullens Lane, Woodlyn, Pa.

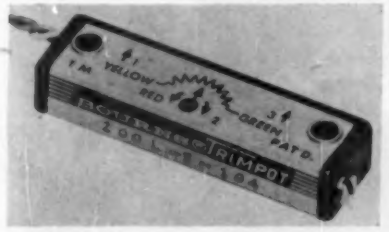


• **Microminiature wire-wound potentiometers,** called Acesets, are now obtainable in 13 resistance values between 50 and 100,000 ohms. Said to offer greater temperature cycling stability than other types of comparable size through use of 20 ppm. temperature co-

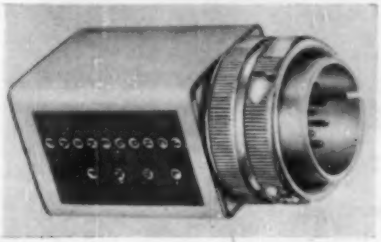


efficient wire, electrical specifications are: heat dissipation 2 watts at 60C, voltage breakdown 1,000 vdc., electrical angle 325 deg. nominal, resistance tolerance ±10%, linearity ±5%. Size is ½ in. dia. by ⅜ in. length. Ace Electronics Associates, Inc., 99 Dover St., Somerville, Mass.

• **Miniature screw-actuated potentiometer,** No. 200L-2-104, provides resistance range to 100,000 phms in unit measuring ¼ x ⅜ x 1¼ in. Resolution of 100K model is 0.14%, power rating is



0.25 at 70C, maximum operating temperature is 105C. Adjustment accuracy is obtained through 25 turns of rotation for screwdriver setting. Bourns Laboratories, Inc., P.O. Box 2112, Riverside, Calif.



• **Relay,** Type E420D, is designed to meet requirements for airborne and missile applications of MIL-R-5757B and MIL-R-6016B. Unit measures 1⅜ x 1⅜ x 2 in. Electro-Mechanical Specialties Co., Inc., 1016 North Highland Ave., Los Angeles 38, Calif.

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Reading Display Keyed to Business Flying

By Erwin J. Bulban

Reading, Pa.—Safety hints on light twin flying, discussions of new de-icing systems specifically designed to increase lightplane all-weather capabilities and planned policy changes in Civil Aeronautics Administration's handling of supplemental type certificates were the main points of a recent big turnout here of business flyers for Reading Aviation Services' Ninth Annual Maintenance and Operations Meeting.

A one-day affair since its initiation eight years ago—when static display exhibitors outnumbered the guests—Reading's show this year was made a two-day meeting in order to provide time for considerably expanded displays and discussions keyed to business flying.

An entire large hangar was given to providing booth space to the approximately 60 equipment and services companies, another building was used to serve luncheons for the approximately 2,000 guests that attended the meeting, some arriving from as far away as Dallas and Omaha.

An estimated 270 business and private aircraft were flown in, ranging from a 1928 Waco 10, which took first place in the antique aircraft division of Reading's annual aviation awards, to U.S. Industries' Convair 440 (judged as having the best interior of the planes displayed).

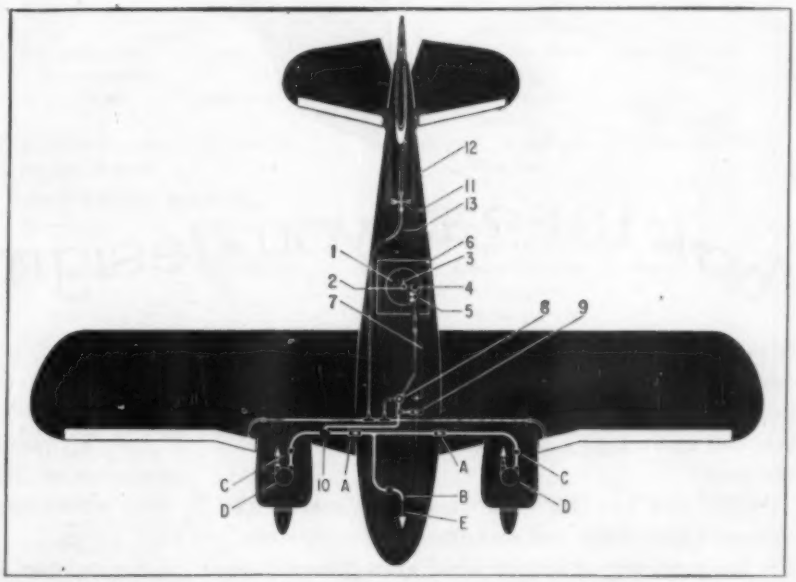
Actual Flight Checks

Many exhibitors, in addition to static displays, had airplanes fitted with their particular equipment, providing guests with opportunity to make actual flight checks of the gear. United Air Lines actually op rated a two-day course for business pilots covering weather radar equipment operation and thunderstorm meteorology. Some two-dozen corporations put 43 pilots through the two-day curriculum at a cost of $75 per trainee.

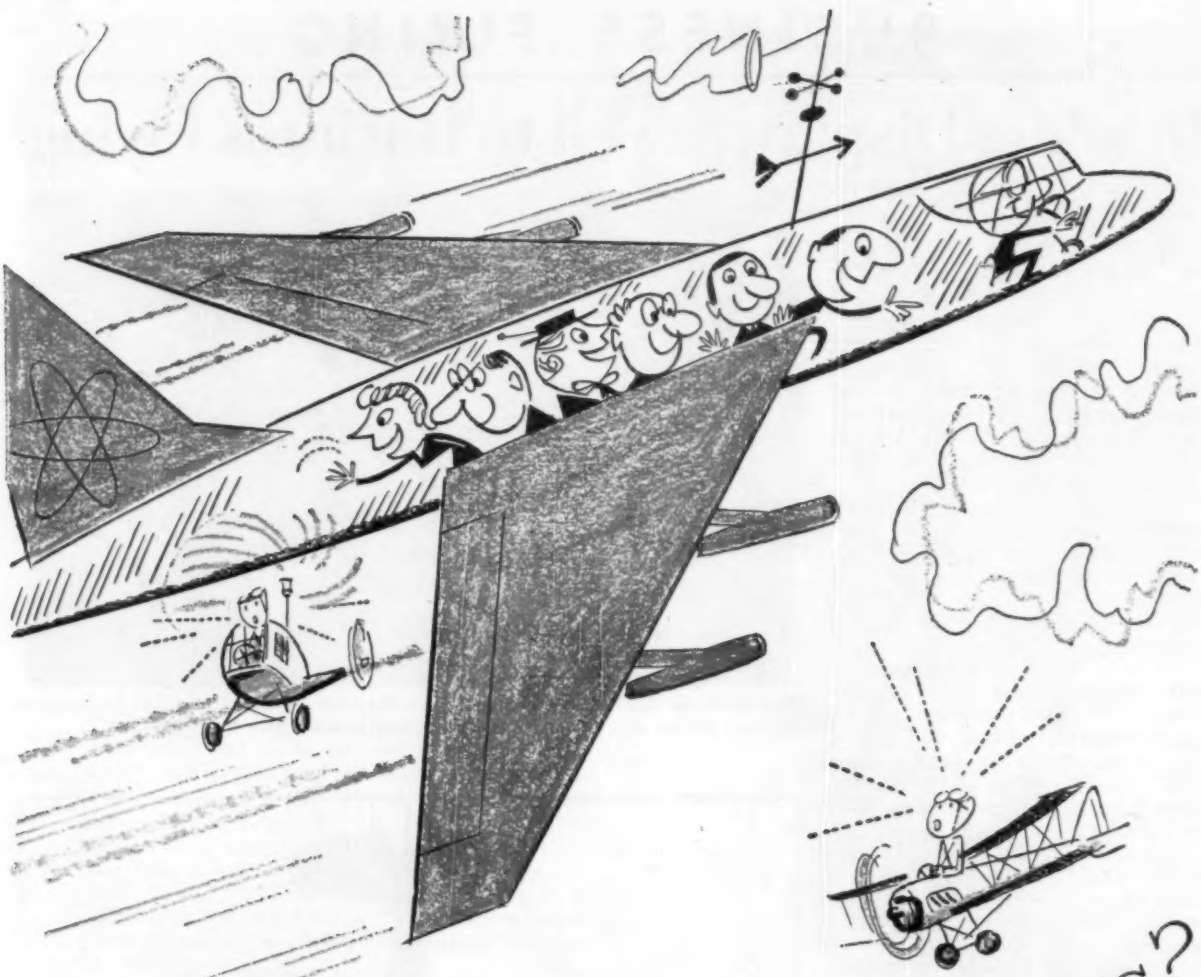
Light-twin pilots received practical pointers on engine-out operating procedures during discussion periods, particularly on the importance of gaining height on takeoff to enable safe go-arounds or better choice of landing spots in event a powerplant quits. CAA representative noted a tendency of many pilots to build up speed during takeoff at the sacrifice of altitude, which severely limits them, since they may have insufficient height in which to maneuver if an emergency arises.

There are some, he noted, who go to the other extreme: placing the emphasis

TAILORED specifically to business flying, Reading aviation display drew 270 airplanes of all types, portion of which are shown above, and approximately 2,000 guests.



LIGHTWEIGHT Goodrich de-icing system for fast-growing light twin business plane fleet weighs about 50 lb. This typical installation in a Piper Apache is also representative of layout in other airplanes. Engineering details of system include: 1—3,000-psi, air accumulator; 2—accumulator outlet fitting; 3—charging valve; 4—shut off and vent valve; 5—regulator, gages and relief valve; 6—mounting plate; 7—remote operating cable; 8—distributor valve; 9—air dump valve; 10—AN 824-60 tee; 11—AN 937-60 cross; 12—3.8-in. B-118 de-icer hose; 13—½-in. i.d. .028 wall aluminum tubing. Also: A—vacuum system check valve; B—vacuum regulator; C—vacuum relief valve; D—vacuum pump and E—vacuum to instruments. De-icer boots (light areas in drawing) are permanently cemented to surfaces, have spanwise inflation tubes. Portion of system, comprising approximately half its weight, can be removed and stored when equipment is not required. Another system, utilizes scaled down, light pumps developed by Bendix Aviation's Utica Division to replace the pneumatic bottle system. Piper is also studying Freon gas system for anti-icing the Apache.



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on gaining height at the expense of maneuvering speed with one engine out. In either case these pilots are faced with the alternative of a highspeed crash or a spin at low altitude.

A good rule of thumb is to plan to attain an arbitrary altitude to provide sufficient maneuvering height above the ground should an emergency arise. CAA personnel who are coached in emergency procedures at the agency's Aeronautical Center at Oklahoma City, use 400 ft. as their "obstruction clearance altitude" to provide height for go-around and give them time to initiate emergency procedures.

Private pilots were also cautioned to pay attention in their flight planning to takeoff conditions such as temperature and airport altitude. Airlines use certificated flight dispatchers to calculate airplane configuration, but it is absolutely legal for a private airplane to take off at maximum gross regardless of temperature and altitude at the airport, although these can have serious consequences on the airplane's performance. CAA personnel at Oklahoma City, flying the light twins, note that at the 1,300-ft. altitude of their airport, the airplanes need approximately five miles-per-hour greater takeoff speed than at sea level; this is attributable to the fact that small engines develop their maximum power at sea level.

STC Changes

Important policy changes being prepared by Civil Aeronautics Administration in its supplemental type certificate (STC) procedures, governing modification of business aircraft, are designed to answer industry complaints that current methods are causing it and their customers considerable hardship.

Details of new policy, based on a comprehensive field survey by a CAA team, are scheduled for release soon, Engineering Division Chief Henry Weeks reported. It is expected that the changes will place greater responsibility with modification companies to speed modification approval process. CAA will be in a better position to work over engineering data involved in modification since it has been increasing its engineering staff in recent months, Weeks noted, due partly to ability to offer better salaries and also because of greater availability of personnel because of industry slow-downs.

Ability of a company to oversee its modification programs will depend upon the quantity and quality of its engineering staff; Weeks advised such companies to push buildup of qualified technical personnel so that they will be in a position to handle increased responsibilities. CAA is also accelerating a program of qualifying industry designated engineering representatives (DERs) who will be capable of approving prototype aircraft and subsequent modified aircraft.

New equipment coming along suitable for increasing all-weather capabilities of light twin aircraft by providing suitable de-icing gear was discussed by Howard Piper, vice president, Piper Aircraft Corp. Basic types of new equipment, aimed at decreasing weight —a critical factor in these small aircraft include:

• **Anti-icing system,** employing liquid Freon heated to gaseous state and circulated along leading edge surfaces of wings and tail, has been devised for Apache installation by a former Servel

Awards—Ninth Maintenance & Operations Meeting—Reading Aviation Services

ANTIQUES	TYPE AIRCRAFT	REG. NO.	OWNER	PILOT
Oldest antique	1928 Waco 10	5852	Robert Hoover Harrisburg, Pa.	Same
Best restored	1932 Waco UEC	12472	John B. Stirling Arlington, Va.	Same
SINGLE ENGINE				
Best exterior	Beech G17	34R	J. J. Ryan Greensboro, N. C.	R. V. Brugh
Best equipment instrumentation	Cessna 182	182M	Ed Chadderton Sharon, Pa.	Same
Best interior	Helioplane	4135D	Laren Pitcairn Philadelphia, Pa.	Same
Best of Class	Cessna 182	182M	Ed Chadderton Sharon, Pa.	Same
TWINS UNDER 5,000 LB.:				
Best exterior	Cessna 310B	3310	N. Y. Wire Cloth York, Pa.	Stanley Smith
Best interior	Piper PA-23	3286P	Oval Wood Dish Hartford, Conn.	Burt Whitcomb
Best equipment instrumentation	Cessna 310B	3310	N. Y. Wire Cloth York, Pa.	Stanley Smith
Best of class	Cessna 310	310M	Ed Chadderton York, Pa.	Joseph Buckwalter
Honorable mention for best of class	Cessna 310	3310	N. Y. Wire Cloth York, Pa.	Stanley Smith
TWINS 5,000 TO 12,000 LB.:				
Best exterior	Aero Commander 520	2636B	Summitville Tiles Summitville, Ohio	Fred H. Johnson
Best interior	Beech D-18	44624	Braund Plywood Birmingham, Mich.	Wm. M. Gunn
Best equipment instrumentation	Aero Commander 680	6841S	Stockpole Carbon St. Marys, Pa.	Richard Y. Cargill
Best of class	Beech D-18S	80048	Va. Coal & Iron Philadelphia, Pa.	Chuck F. Sowa
Honorable mention for interior and exterior	Beech D-18S	1827M	C. L. McMahon Tulsa, Oklahoma	Same
Honorable mention for equipment and instrumentation	Beech D-18	44624	Braund Plywood	Wm. M. Gunn
Honorable mention for best interior	Aero Commander 520	2636B	Summitville Tiles Summitville, Ohio	Fred H. Johnson
TWINS OVER 12,000 LB.:				
Best exterior	Howard Super Ventura	N200P	National Distillers & Chem. N. Y. C.	Harold Curtis
Best interior	Convair 440	85U	U. S. Industries Stratford, Conn.	R. G. Reckner
Best equipment	Howard Super Ventura	100P	National Distillers & Chem.	Harold Curtis
Best of class	Howard Super Ventura	N200P	National Distillers & Chem.	Harold Curtis
Flag ship of fleet	Howard Super Ventura	N200P	National Distillers & Chem.	Harold Curtis

PLANE FAX

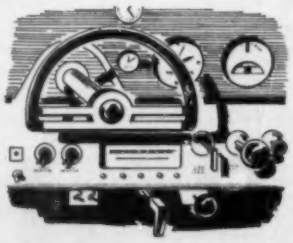
by STANDARD OIL COMPANY OF CALIFORNIA

Planting trout by air into Cascade lakes

"Bombing" mountain lakes with fingerling trout, Sam Whitney has revolutionized Oregon's fish-stocking program. In just one month he "plants" more than 350 lakes by flying 150 feet above the water — high enough for the fish to lose their forward motion before they hit. Pack trains previously spent all summer stocking only 60 lakes.

"Dropping toward those small lakes in timber country can be a lot of fun," says Mr. Whitney, "as long as I know I have enough power to get up and out again. That's why I use Chevron Aviation Gasoline — it *always* gives me the extra power I need, without a miss. It never fouls my plugs, either. There's no better gas made.

"I know RPM Aviation Oil is the best 'engine insurance' I can get. It keeps my planes running smooth and free for hundreds of extra hours, with never a stuck valve or ring. In fact, when a customer comes to my base at Newberg, Oregon, with that trouble, I usually cure it just by flushing out his engine with 'RPM'."



TIP OF THE MONTH

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AVIATION OILS RPM

T.M.'S "RPM," "CHEVRON," "PLANE FAX," REG. U. S. PAT. OFF.

SEA LEVEL CRUISE SPEED of 145 mph. is claimed for this 1,300-lb. gross weight single-seater designed and built by four engineers in their spare time over a period of about five years, near Bristol, Pa. Displayed at Reading Aviation's maintenance and operations forum the HPK Model SP-1 is powered by a 115-hp. Lycoming O-235-C1, spans 25 ft. and is 19.1 ft. long and 8 ft. 1 in. high. Wing area is 99 sq. ft., wing loading is 13 lb./sq. ft. Fuel capacity is 36 gal. in tanks at wingtips. Takeoff distance, no wind, is reported at 400 ft. and stalling speed, flaps down, at sea level, as 50 mph. Designers-builders Harold Hayden, Robert Kinney, Arthur Payne and Reno Benner are now working on a two-place version.

refrigerator engineer, Dr. Robert Taylor, Evansville, Ind. Installation has been tested on a Piper Apache, the gas being heated in the engine exhaust system, the Freon steam raising skin temperature some 50 deg. above ambient temperature to prevent or remove ice formation. Gas is contained in two sheets of aluminum bonded together, having a chamber of approximately ⅛ in. x 1" in.; the sheets fastened to the wing and tail surfaces by Rivnuts.

Advantages of this system, Howard Piper noted, was that it was fastened permanently to the airplane and required no pilot control since it was always operating. Weight was estimated at 50-60 lb. Estimated price is $3,500 installed. Crescent City Aviation, Evansville, plans installations available this fall.

• **New Goodrich Type 23** lightweight de-icing gear, is more conventional pneumatic expanding boot-type equipment having spanwise inflatable tubes energized by a compressed air supply stored in a 3,000 psi. bottle. For an average business airplane with air at 1,000 psi., endurance of the storage bottle is estimated at approximately two hours when activating the system once every three minutes. System eliminates conventional type using engine-driven pumps to supply pressurized air source, also associated oil filtering and separating equipment, timers, solenoid valves and miscellaneous plumbing, thus cutting weight to approximately 50 lb. and bringing price down to under $3,000 installed. Cycling of the de-icing system is done by the pilot, a complete inflation and deflation actuated by a single ¾ in. push on a control shaft. Rubber-type de-icing boots are permanently cemented to the wing and tail surfaces, mechanical parts package can be removed and stored when not required. Equipment will be available this fall.

• **Another de-icing system** under development is a modification of the above Goodrich equipment using scaled-down pumps developed by Utica Division of Bendix Aviation, eliminating the compressed air bottle installation. System is expected to weigh approximately 44 lb., will cost under $3,000 and is expected to be available this year, in kit form.

Piper has developed a kit for preventing skin damage from ice being thrown from the Apache propellers to adjacent fuselage. Kit consists of panels of Royalite shock-absorbent plastic panels which can be fastened to the fuselage skin using Rivnuts, leaving a ¾ in. gap between the panels and fuselage skin. Kits will be available to Apache operators this fall.

Method of anti-icing antennas, utilizing heated Freon gas steam, has also been developed by Dr. Taylor. Liquid Freon is vaporized by a coil-type heating element in the base of the hollow antenna. This item is also expected to be available this fall.

Piper Inaugurating Learn-to-Fly Plan

A learn-to-fly-on-vacation program designed to make it convenient for prospective pilots to speed the process of getting their licenses is being inaugurated this summer by Piper Aircraft Corp.

Plan is being tied to a popular New England resort so that would-be pilots and their families can enjoy normal vacation activities while also accumulating most of the time required for a private license. Program is also applicable to current holders of licenses who could take advantage of their time off to get instrument ratings.

Prime reason for the idea: to make obtaining a license easy for those who are normally so busy during working periods that they either find it hard to get away from their offices or can give so little time normally to learning to fly that the process stretches out to the point where they actually become discouraged and quit.

Company points out that a person can handle two or three lessons a day safely without strain and thus solo within a week. Accelerated pace actually reduces amount of instruction time required, since student retains knowledge better than if same time was spread over a longer period and requires less time for brushing up prior to taking next step.

Piper's initial learn-on-vacation center is Martha's Vineyard, off the Massachusetts coast. Martha's Vineyard Air Service will have available a fleet of Tri-Pacers to handle the first step of a program which Piper will set up on a nationwide basis if this experiment proves out.

Area was selected because it has been a longtime vacation and tourist area and provides numerous facilities for relaxation in addition to variety of living facilities to suit most budgets. Area is also suitable for instrument training because of ADF, ILS, omni, LF range, radar and other navigational aids available nearby.

Fixed Loop For ADF Has No Moving Parts

Fixed loop for automatic direction finders, reported to require no maintenance and providing low-drag lightweight installation, and a new ADF transducer permitting non-directional low-frequency transmitters to be used for omni-range type guidance, are being marketed by Lear, Inc.

• **Non-rotating gonio loop** has no moving parts, these instead being mounted on or near the airplane's radio rack, providing superior environmental conditions and requiring considerably less power than usually necessary for rotating a conventional loop since motor size is reduced. Also, use of a goniometer eliminates one set of synchros necessary for conventional loops, reducing overall system errors. Low inertia of the goniometer also reduces indicator's overshoot.

New Lear equipment replaces present rotating loop antennas, requires no

modification of installed ADF equipment. Loop is only one inch thick and requires a single one-inch diameter hole in the aircraft skin for mounting. Because of the unit's light weight, no additional structure is required for installation. Loop is completely locked in oil-and-hydraulic-fluid-proof sealed plastic foam to obviate maintenance.

When added to Lear ADF-100 or ADF-12E-2, unit costs approximately $125 uninstalled; if added to other types of ADFs, price will be some $500.

• **ADF transducer** weighs under two pounds, can be applied to any make of automatic direction finder used in Lear's integrated flight equipment. Using this combined equipment, pilots can fly inbound or outbound radials, making manual or automatic approaches on non-directional low-frequency transmitters, such as broadcasting stations.

Camair Twin-Navion Production Resumed

Production of Twin-Navion conversions has been taken over by Camair Corp., a fixed base operation at New Kingstown, Pa., which has taken the project over from the former Galveston, Tex., owners. New company has a demonstrator 480 Twin-Navion flying, expects to have its number one production model incorporating some important changes flying in approximately three months.

Key feature of the new Camair 480 will be switch to fuel-injection model Continental 0-470-B 26-hp. engines, which are expected to provide important fuel economies and also eliminate carburetor icing problems. Airplane will sell for approximately $32,000 without radio.

New company has retained name of former conversion firm which developed this twin-engine configuration of single-engine Navion business plane. Tools, dies and parts were transferred to Pennsylvania late last summer.

Canada Oil Activity Builds Helicopter Use

Increasing activity in exploration work this summer by major oil companies in the Canadian northwest will require a major fleet redistribution by Okanagan Helicopters Ltd. of British Columbia.

A total of 15 Bell helicopters and one Sikorsky S-55 will work in the Northwest Territories, northern Alberta and British Columbia and the Yukon, according to G. W. McPherson, president of Okanagan.

McPherson said in Vancouver that Shell Oil Co. of Canada has contracted for six Bells, which will be engaged in transporting exploration and survey crews during the summer months. California Standard will use a Sikorsky S-55 to transport oil and fuel to supply camps, from which four Bells will operate on exploration work.

Imperial Oil has a contract for three Bells, while Sinclair and Triad will each use one Bell.

PRIVATE LINES

Look for definite swing to fuel injection engines for business planes covering wide range of powerplants. Continentals's IO-470-C 250-hp. engine installation on 1958 Beech J35 Bonanza has sparked industrywide interest in this type of equipment because of elimination of carburetor icing problem and reportedly good fuel economy. Lycoming Division of Avco Manufacturing Corp. also is planning fuel injection equipment installation on its GSO-480, GSO-540 and GSO-720 powerplants, favoring Simmonds automatic system requiring no pilot control.

New wingtip fuel tank installation for Beech Bonanza, providing total of 24-gal. auxiliary fuel, is under development by Safe Flight Extenders Co., Stamford, Conn., which has been flying prototype installation engineered and built by Doman Helicopters. Fuel tanks, of all-metal, welded design, are expected to increase Bonanza normal range by some 450 mi. and require no structural changes. Fuel lines connect to standard Bonanza four-way valve. Installations are expected to be available in kit form in about a month at cost of approximately $600 per set.

Skycraft Design, Old Star Airport, Langhorne, Pa., reports it has installed its metal wings on approximately 130 Ercoupes, 150 Cessna 120s and 140s, and 50 Stinsons. It is currently working on metal Stinson aileron design and also has program for all-metal wings and fuselage for Piper Tri-Pacer under development.

Planned maintenance program, to enable business aircraft owner to project cost of equipment over a scheduled period and provide him with a manual designed to his requirements, is being developed by Southwest Airmotive Corp., Love Field, Dallas, Tex. Firm is distributing detailed flat rate overhaul catalogs covering Aero Commander, Cessna 310, Twin Beech, Bonanza, Twin-Bonanza, DC-3 and C-47 and Lodestar. Booklet also has instrument overhaul prices.

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NEW AVIATION PRODUCTS

Nose Wheel Tractor

Aero Tractor, small nose wheel tractor, allows one man to move light, single and twin engine tricycle gear aircraft. Employing a hydraulic jack to lift nose wheel, device is said to be adaptable to all tricycle gear planes.

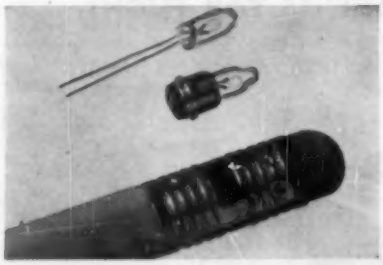
Throttle-controlled Briggs & Stratton engine provides speeds of ¼ to 3 mph. Tractor drive automatically returns to neutral when lever is released, and brake permits parking on incline. Aircraft in photo is Cessna 310.

Aero Vector Division, Yuba Consolidated Industries, Inc., 1084 Martin St., San Francisco, Calif.

Guidance System Motor

Motor designed for guidance systems, flight simulators and other aircraft and missile applications has a gear ratio of 7,000,000 = 1, the manufacturer claims. Motor turns at more than 3,000 rpm., and the output shaft makes one revolution every 32 hr. In simulated flight application it will return to zero as soon as it is turned off. Unit weight is 3 lb.

Dalmotor Division, Yuba Consolidated Industries, Santa Clara, Calif.



Instrument Lamp

Miniature lamp, measuring ⅛ by ¼ in., is designed for integral lighting of aircraft instruments. Life expectancy of 60,000 hr. of continuous burning at 5 volts makes lamp the smallest commercially designed long-life lamp, the manufacturer states.

Lamp is said to withstand severe vibration and voltage surges up to 30 volts.

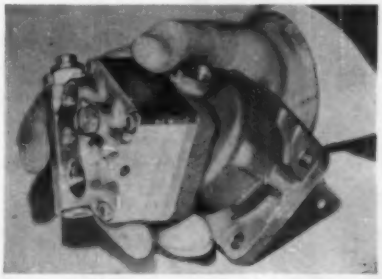
Chicago Miniature Lamp Works, 1500 N. Ogden Ave., Chicago 10, Ill.

Wind Indicator

Windscope, remote reading wind-speed-and-direction instrument, indicates both wind direction and velocity on a single dial. Costing less than $100, instrument is aimed at small airport, amateur meteorologist market.

Instrument requires no outside electrical power. Revolving cups generate their own power, while a 1½ volt flashlight battery, installed in indicating panel, transmits signal from direction vane. Battery is drained only when wind direction is being checked. Panel, graduated in both miles per hour and Beaufort scale, ordinarily shows wind velocity of 0 to 25 mph. When winds exceed 25 mph., indicator can be reverted to a sub-scale of 25 to 100 mph. by depression of a toggle switch. Wind direction is obtained by lifting this same toggle.

Taylor Instrument Companies, 95 Ames St., Rochester, N. Y.



Variable Flow Pump

Variable displacement axial piston hydraulic pump for aircraft and missile application is comparable in size to current fixed displacement pumps.

Series PV-3906 pump is rated at 3,000 psi. It is capable of intermittent operation at 24,000 rpm. displacing 9.7 gpm. Maximum recommended speeds are 12,000 rpm for aircraft application and 18,000 rpm. for missile use, the maker states. Weight is 2.4 lb.

Vickers Inc., Detroit 32, Mich.

Hi-Temp Limit Switches

Two hermetically-sealed limit switches are suited for use near jet afterburners, missile exhausts and other high temperature locations. Operating temperature range for both switches is −65F to +600F.

One of the switches, 12HR1-S, has a plunger actuator for in-line motion operation while the second, 22HR1-S, has a roller plunger actuator for operation by cams or slides.

Contact arrangement consists of two single-pole double-throw circuits. At

sea level and 50,000 ft. each circuit is rated at 5 amp., 28 vdc. resistive load; 2 amp., 28 vdc., inductive load.

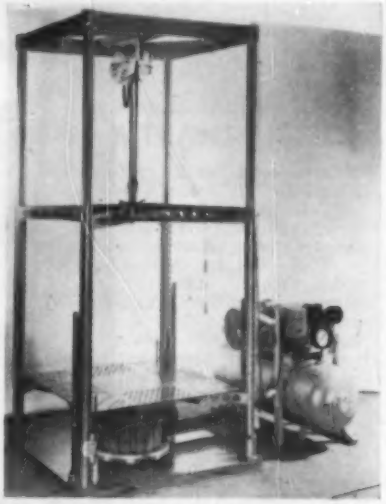
Fabricated of stainless steel, the switches are moisture proof, dust proof and impact resistant, the manufacturer states.

Micro-Switch of Freeport, Ill., Division of Minneapolis-Honeywell Regulator Co.

Drop Test Machine

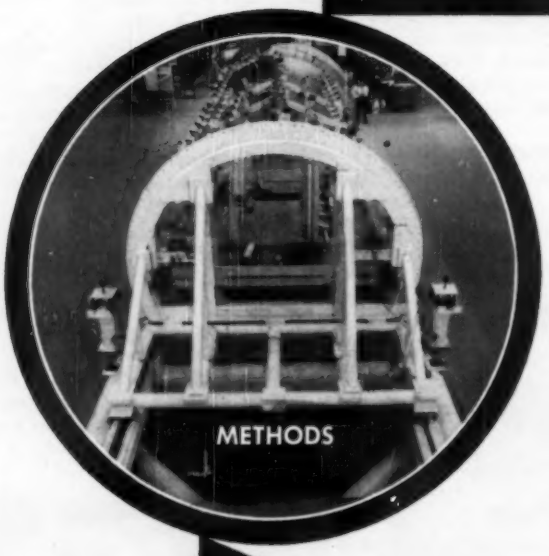
Drop test machine for testing aircraft and missile equipment provides shock forces in excess of 77Gs on specimens weighing up to 400 lb.

Model 30K drop test machine consists of a piston type platform, which is subjected to a free fall into a cylinder of air pressure. Uncertainty of impact



repeatability inherent in conventional type sand bed machines is said to be eliminated in this test device. Provisions are made to mount an accelerometer which feeds data to a recording device.

Aeroflex Laboratories, Inc., 34-06 Skillman Ave., Long Island City 1, N. Y.



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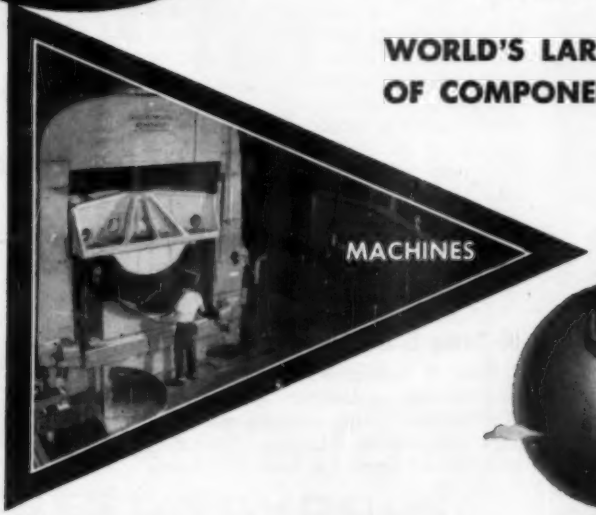

MAIN PLANT AND HEADQUARTERS: CHULA VISTA, CALIF.; PLANT: RIVERSIDE, CALIF.; ASSEMBLY PLANTS: WINDER, GA.; AUBURN, WASH.

Model Shows Italian Transport Helicopter Details

First details of the Italian Agusta Z-101D gas turbine helicopter show a conventional layout powered by three Turbomeca Turmo 3 engines. All three would be used to power a 27-place version; for an alternate configuration with 18 places, one of the turbines would be shut down. Weights for the 27-place version would be: normal gross, 17,000 lb.; useful load, 6,950 lb.; overload gross, 17,600 lb. Performance for the 27-place version would be: maximum speed, 152 mph.; cruise speed, 131 mph.; maximum rate of climb, 1,140 fpm.; hovering ceiling with ground effect, 9,850 ft.; without ground effect, 4,920 ft. Weights for the 18-place version would be: normal gross, 12,650 lb.; useful load, 4,850 lb.; overload gross, 13,200 lb. Performance for the 18-place version: maximum speed, 137 mph.; cruise speed, 118 mph.; maximum rate of climb, 1,280 fpm.; hovering ceiling with ground effect, 12,150 ft.; without ground effect, 6,230 ft.

WHO'S WHERE

(Continued from page 15)

Honors and Elections

Dr. Joseph C. Patrick, one of the founders of Thiokol Chemical Corp. and now a consultant to the company, will receive the 1958 Charles Goodyear Medal, the highest honor in rubber chemistry, at the national meeting of the American Chemical Society in September.

Allen F. Donovan, vice president of The Ramo-Wooldridge Corp.'s Space Technology Laboratories, has been cited for outstanding service to the Department of the Air Force. An Air Force scroll stated in part, ". . . contribution of his time and talents to the consideration of Air Force scientific problems . . . have earned him the sincere appreciation of the United States Air Force."

Capt. David R. Hull (USN, ret.), a vice president of Raytheon Manufacturing Co., has been elected president of the Electronic Industries Assn., Washington, D. C. Mr. Hull succeeds Dr. W. R. G. Baker, former vice president of General Electric Co.

Roy E. Marquardt, president of Marquardt Aircraft Co., has been appointed Aircraft Accessories Industry Finance Chairman of the United States Committee for the United Nations.

W. E. Zisch, vice president and general manager of Aerojet-General Corp., has been appointed to membership in the newly formed Missiles Advisory Group of the National Security Industrial Assn.

Edwin A. Link, president of General Precision Equipment Corp., has been appointed to the executive committee of Flight Safety Foundation, Inc., New York, N. Y.

Henri Busignies, president of Federal Telecommunication Laboratories, has been awarded an honorary Doctor of Science degree by Newark College of Engineering, Newark, N. J.

Dr. Jason L. Saunderson, vice president-chemical instrument engineering of Baird-Atomic, Inc., has been awarded an honorary Doctor of Science degree by Morningside College, Sioux City, Iowa.

Maj. Samuel W. Tyson has been awarded the first Koren Kolligan, Jr. Trophy. The trophy will be awarded annually to the USAF pilot or aircrewman who most successfully copes with an emergency situation in flight.

Changes

David P. Perry, senior engineer, and **William F. Hurley**, advertising manager, Potter Instrument Co., Plainview, N. Y.

Dr. Sidney J. Stein, director of engineering and research, International Resistance Co., Philadelphia, Pa. Also: **Leo J. Jacobson**, head-engineering division; **Dr. John Bohrer**, head-research division; **David E. McElroy**, manager-plastics research.

E. W. Schoen, chief metallurgist, Huck Manufacturing Co., Detroit, Mich.

Statham Instruments, Inc., Los Angeles, Calif., has appointed the following vice presidents: **Edmund Basich**, for manufacturing; **Mario Di Giovanni**, for engineering; **Gilbert N. Rosa**, for marketing, **Gordon Earl**, treasurer. Also: **Ray L. Donovan**, vice president and general manager, of the company's subsidiary Statham Development Corp., Los Angeles, Calif.

Frederick F. Wood, assistant to the vice president-publicity and advertising, The International Nickel Co. of Canada, Ltd., and

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Write for Bulletin 147-56

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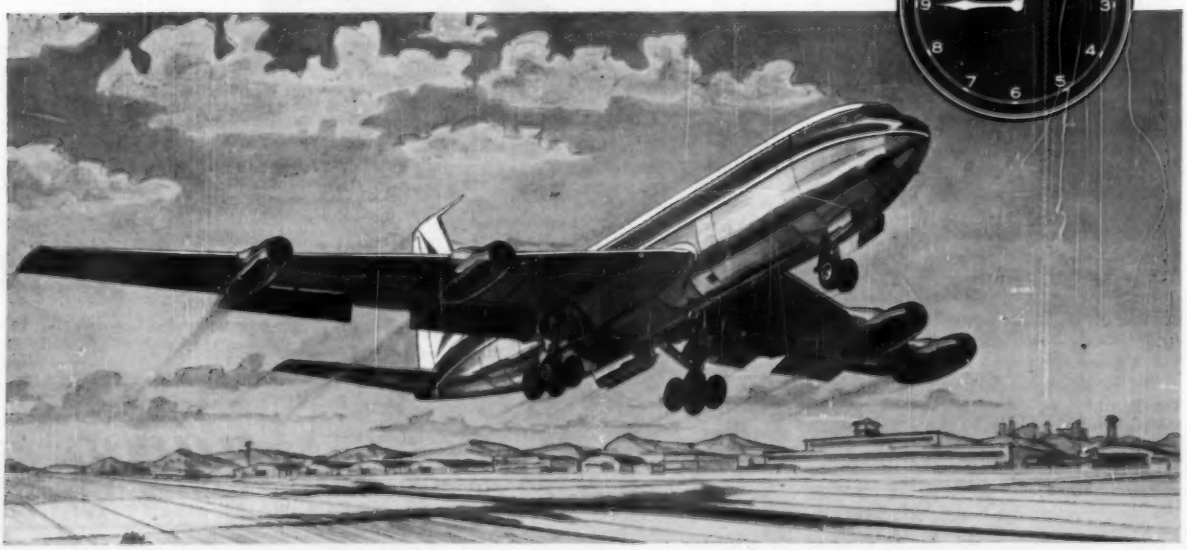

assistant vice president-publicity and advertising, The International Nickel Co., Inc., New York, N. Y.

Perry R. Roehm, director of marketing, International Telephone and Telegraph Corp., New York, N. Y. Mr. Roehm formerly was president and a director of Norden-Ketay Corp.

W. T. Harmon, manager of marketing, Production Engine Department, Aircraft Gas Turbine Division, General Electric Co., Cincinnati, Ohio.

Richard P. DeGrey, program planning division manager, Missile Systems Division, Lockheed Aircraft Corp., Van Nuys, Calif. Also: **Clare W. Harris**, head-newly established quality assurance branch of Lockheed's Missile Systems Division, Sunnyvale, Calif.

Malcolm J. Rowe, manager of marketing, Airborne Instruments Laboratory, Mineola, N. Y.

R. C. Uddenberg, manager-Seattle test and plans, Pilotless Aircraft Division, Boeing Airplane Co., Seattle, Wash. **A. Wheeler Warren** succeeds Mr. Uddenberg as staff engineer-operations planning. Also: **Tex S. Lines** in charge of the Division's advanced projects engineering unit's special projects.

Fred B. Montgomery, manager-engineering experimental shop, Aviation Gas Turbine Division, Westinghouse Electric Corp., Kansas City, Mo.

George S. Brown, Jr., manager-engineering and manufacture, Western Design & Manufacturing Corp., Santa Barbara, Calif.

John B. Donner, project manager-B-52 electronic defense subsystem, Sylvania Electronic Systems, division of Sylvania Electric Products, Inc., Waltham, Mass.

Glen F. Crist, general superintendent, and **Edward J. Szkaradek**, quality control manager, Clemco Aero Products, Inc., Compton, Calif.

Karl Fritsch, chief development engineer, Vertol Aircraft Co. (Canada), Ltd., Arnprior, Canada.

Norman Hiestand, manager-product development, Instrument Division, Varian Associates, Palto Alto, Calif.

Col. William S. Evans, Director of Information Services, Headquarters, Air Research and Development Command, Andrews AFB, Md.

Leslie P. Hawes, operational manager, Space Corp., Garland, Tex.

Brig. Gen. John M. Sterling (USAF, ret.), director of operations in Europe, Republic Aviation Corp., Farmingdale, N. Y. Also: **William P. Burch**, director of military sales, Republic's Helicopter Division.

Dr. Raymond L. Bisplinghoff and **Dr. Wayne B. Nottingham** of Massachusetts Institute of Technology appointed consultants to National Research Corp., Cambridge, Mass. Also: **John M. Lee** named space activities manager.

B. E. Heacock, manager-preliminary design department, Stavid Engineering, Inc., Plainfield, N. J.

T. William Hefferan, Jr., Dayton, Ohio, representative, Vitro Corp. of America, New York, N. Y.

Jay R. Borden, senior instrumentation engineer, Technical Products Division, Waste King Corp., Los Angeles.

Richard M. Recktenwald, chief engineer, Menasco Manufacturing Co., Burbank, Calif.

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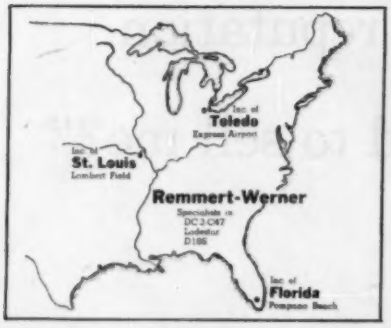

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Staff Engineer William Howard (center) reviews gearing accuracy requirements of test equipment with electronic circuit designers.

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P-8157, Aviation Week
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Agency—Fuller, & Smith & Ross, Inc.

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LETTERS

Salesmanship

The claim is made by Mr. Casad in your May 19 issue (p. 114): "Accuracy of statement is of no concern to him (the salesman), and doubt is something to be counteracted by more extravagant claims." This is a generalization based on limited observation—probably at carnival sideshows or on TV screens. It certainly does not apply to the kind of salesmanship needed to upgrade engineers.

Salesmanship is not deceit or trickery. Salesmanship, in my book, is: presenting your own products or ideas in terms of the buyer's self-interest. Your statements must be accurate. Extravagant claims must be avoided. And the buyer's self-interest must be your prime concern.

Management people are not suckers for the exaggerated untrue claims that Mr. Casad seems to believe are salesmanship. Management is constantly seeking what is best for the organization. And if the engineer will apply his analytical mind and his creative imagination to the task of proving the benefits his ideas can give the organization, he will find a receptive audience. But he will make no progress if he acts on the false premise that he has to be a liar to sell his ideas.

C. W. METCALF
Engineered Advertising
Sharon, Mass.

Collision Solutions

The recent rash of mid-air collisions and the ever present danger of a recurrence of these brings to my mind a possible solution on cutting down the odds against such collisions.

The controlled airspace above the domestic zone (U.S.) is limited and will continue to be limited for some time. Although radar is a wonderful and fascinating gadget, it is by no means a "cure-all," and we will not realize a true radar or electronically controlled airway for at least another three to five years (I would even "guess-ta-mate" a figure of seven to 10 years before we have large areas of the U.S. under positive control to the degree we desire)..

In the meantime, steps should be taken to require all aircraft that fly in the U.S. domestic zone to have certain modifications that would help in the visual identification of an aircraft.

A. Rewrite CAR to specify the following:

1. Require all aircraft (civil, air carrier, military, and private) to have broad bands of iridescent red or orange paint on the top and bottom of wings, sides of fuselages, and tails. (Some birdmen will scream in anguish at this and claim we will all look like Von Richtofen's circus, but better the flying circus look than a pile of burning metal in a wheat field or in a residential area).
2. Require all civil air carriers and military aircraft to have red rotating lights (anti-collision light) both on the top and bottom of the fuselage.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

3. Require these lights to be turned on at all times while airborne.

Marginal VFR days, coupled with industrial haze, are especially bad for the possibility of mid-air collisions. When there are bright VFR days, we have a tendency to relax our vigil, and in doing this we again increase the possibility of a mid-air.

To some, these suggestions listed above may seem unnecessary to a degree, but each aircraft that the pilot can see is one that he won't hit. Also, it lessens that "one in a million" chance of the collision.

LCDR LAVERNE W. DILTS, USNR
Naval Supply Depot
Bayonne, N. J.

Aircraft Visibility

Article after article in AVIATION WEEK and all other aviation publications concerning the mid-air collision problem. Many proposed solutions to the problem, some of which will be successfully applied to some degree. In these same publications the new jet airliners are pictured inside and out, but look at that cockpit. The same old DC-4 visibility problems. How can a pilot be expected to maintain a decent surveillance of the area in which he is flying when there isn't even enough visibility to properly clear the ramp area before taxi? A good place to start lowering the odds on the mid-air is on the drawing board before the airplane ever gets off the ground.

N. B. ATKINSON, COPILOT
Northwest Orient Airlines
St. Paul, Minn.

F-107 Enthusiast

Why not the F-107?

To this reader there hardly seems any real justification for the F-104 which has put piloted aircraft back at least 10 years. For top straight out speed and altitude it is the best in the world. But for operational use it is quite marginal at best. The Navy pilots in the F8Us have had little trouble handling the F-104 with its operational limitations due to marginal control limitations and have gun camera film to prove it; which brings to light the point of control of the high Mach fighter and my argument for the aircraft which should have been built as a tremendous fighter-bomber combination—the F-107. The limits of operation of the F-107 encompass a greater span than any other aircraft that has ever been built.

This aircraft could fly well over Mach 2, could be landed dead-stick easily, pull tight turns at altitude and deliver a store at Mach 2 and still shoot down any present day fighter, out-performing the F-101, F-102, F-104, F-105, and F8U in all these categories taken individually, which are the operationally important ones. For this I see no reason why the American people are not getting their real dollars worth of offense which they have gotten in the past.

When aircraft like the F-107 are passed up for such oddities as the F-104 and F-105, we are not getting the best possible weapon systems available regardless of what propaganda is fed to the poor taxpayer concerning a "good show" versus a real operational capability like the F-107, which was built primarily for the average Air Force operational pilot to do more jobs, faster, easier, safer, and hence more effectively.

These points can be disputed, but taken by and large and concerning the relatively little time spent in flight development of the F-107, they will remain as stated whether we, the people, like it or not.

AN IRATE TAXPAYER AND EXPERIENCED OPERATIONAL FIGHTER PILOT
Los Angeles, Calif.

P. S. Please withhold my name, but as a naval aviator for 16 years I qualify my experience with over 6,000 hours in fighters and attack aircraft and two years as a flight test engineer and at present flying reserve operational squadron aircraft.

Field Altitude

The letter "Cockpit Confusion" in the May 26 issue of AVIATION WEEK (p. 126), by Mr. Trimble, makes sense to me. However, there may be a strong feeling in some pilots that there should be an immediate indication of ground level at the field while making a landing. At the risk of being accused of adding just another gadget to watch, it would be simple to provide a small 1 x 2 in. piece of edge-lighted lucite somewhere over the altimeter. The name of the field could be written on the top half of this lucite and the field altitude on the lower half, using an ordinary grease pencil. If the edge lighting were tied in with the landing gear safe position, it would not be distracting at other times.

CAPT. L. T. MORSE, USN
University of Notre Dame
Notre Dame, Ind.

P. S. Were there no radar altimeters in the crashes reported?

Knowledgeable Youth

My father brought an AVIATION WEEK home today. I like AVIATION WEEK a lot. I am in second grade. I noticed a mistake in the May 26 issue on p. 34. On the last line in the middle column you called the McDonnell Voodoo the F-104A instead of the F-101A. I like this issue so much I wonder if you could send me a copy if you have any extras.

PETER SCHWIMMER
Flushing, N. Y.

(Enthusiastic, sharp-eyed reader Schwimmer is 7¼ years old.—Ed.)

Hydro-Aire's two fresh slices of solid-state power supplies:

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